1933.

QUEENSLAND.

IMPERIAL MYCOLOGICAL INSTITUTE
3 FEB. 1934

THIRTY-THIRD ANNUAL REPORT OF THE BUREAU OF SUGAR EXPERIMENT STATIONS.

REPORT OF THE DIRECTOR

TO

THE HON. THE SECRETARY FOR AGRICULTURE AND STOCK

(*As required by "The Sugar Experiment Stations Act of* 1900").

PRESENTED TO PARLIAMENT BY COMMAND.

BRISBANE:
BY AUTHORITY: FREDERICK PHILLIPS, GOVERNMENT PRINTER.

1933.

QUEENSLAND.

THIRTY-THIRD ANNUAL REPORT OF THE BUREAU OF SUGAR EXPERIMENT STATIONS.

REPORT OF THE DIRECTOR

TO

THE HON. THE SECRETARY FOR AGRICULTURE AND STOCK

(*As required by "The Sugar Experiment Stations Act of* 1900").

PRESENTED TO PARLIAMENT BY COMMAND.

BRISBANE:
BY AUTHORITY: FREDERICK PHILLIPS, GOVERNMENT PRINTER.

A. 46—1933.

Contents.

	Page.
General	5
Figures of the 1932 Crop	7
Sugar Values, 1923-1932	9
The Economic Outlook	11
Work of the Bureau	13
Balance Sheet	16
Division of Soils and Agriculture	17
Seedling Propagation	19
Northern Sugar Experiment Station	23
Central Sugar Experiment Station	36
Southern Sugar Experiment Station	45
Division of Pathology	54
Division of Entomology	62
Division of Mill Technology	71

THIRTY-THIRD ANNUAL REPORT OF THE BUREAU OF SUGAR EXPERIMENT STATIONS.

Director's Report.

TO THE HONOURABLE THE SECRETARY FOR AGRICULTURE AND STOCK.

SIR,—I have the honour to submit the Thirty-third Annual Report of the Bureau of Sugar Experiment Stations for the year ended 31st October, 1933.

H. W. KERR,
Director.

Brisbane, 30th November, 1933.

General.

THE 1933 CANE CROP.

The growing season for the 1933 crop was a most remarkable one. In the Northern and Central districts generally favourable conditions prevailed in the spring and early summer months. In the South, however, droughty conditions persisted until October, when beneficial rains provided suitable planting conditions. Up till this time the ratoons had made little headway, and planting was delayed.

In all areas the summer months were punctuated by unusually long dry spells, which seriously checked crop growth; and in April prospects were generally far from bright. In May further beneficial rains, accompanied by mild temperatures, created conditions which were extremely favourable for continued growth, and phenomenal winter rains ensured a splendid recovery of the backward crop. A continuance of beneficial rains through the early spring month promoted steady growth throughout the harvesting season, and estimated crop yields were, therefore, subjected to repeated revision as the season progressed.

The October estimates show that an absolute record cane crop will be harvested for the season. The marked improvement in crop prospects is clearly demonstrated in the table on page 6, showing the May and October figures.

General—continued.

Cane Estimates Prepared in May and October for the 1933 Crop.

Mill.	Cane Estimates Prepared in—		Increase.
	May, 1933.	October, 1933.	
	Tons.	Tons.	Tons.
Mossman	119,000	132,000	13,000
Hambledon	223,000	211,000	(—12,000)
Mulgrave	220,000	230,000	10,000
Babinda	212,000	240,000	28,000
Goondi	170,000	187,000	17,000
South Johnstone	239,000	283,000	44,000
Mourilyan	165,000	182,000	17,000
Tully	280,000	296,000	16,000
Victoria	225,000	232,000	7,000
Macknade	165,000	195,000	30,000
Invicta	76,000	80,000	4,000
Pioneer	138,000	161,000	23,000
Kalamia	178,000	207,000	29,000
Inkerman	185,000	212,000	27,000
Proserpine	125,000	167,000	42,000
Cattle Creek	45,000	61,000	16,000
Racecourse	110,000	142,000	32,000
Farleigh	115,000	135,000	20,000
North Eton	46,000	65,000	19,000
Marian	110,000	135,000	25,000
Pleystowe	108,000	150,000	42,000
Plane Creek	130,000	170,000	40,000
Qunaba	32,000	49,000	17,000
Millaquin	64,000	99,000	35,000
Bingera	100,000	110,000	10,000
Fairymead	88,000	100,000	12,000
Gin Gin	10,000	18,000	8,000
Isis	80,000	92,000	12,000
Maryborough	25,000	29,000	4,000
Mount Bauple	25,000	27,500	2,500
Moreton	60,000	75,000	15,000
Rocky Point	15,000	16,000	1,000
Eagleby	2,000	2,500	500
Total	3,885,000	4,491,000	606,000

Naturally, late crop growth does not make for a high sugar content, and milling results to date suggest that the sugar yields will be much lower than those of the past four seasons. Late crushings will also result in lower c.c.s. values towards the end of the year. Assuming, however, that 1 ton of 94 n.t. sugar will be made from 7·2 tons of cane (the average for the past four years is 6·9), and that it will be possible to harvest the entire crop, the sugar yield for Queensland will be approximately 623,000 tons.

In addition, it is estimated that the New South Wales crop will amount to 26,000 tons of sugar, giving a total production of sugar from cane of 649,000 tons.

General—continued.

FIGURES OF THE 1932 CROP.

The yield of raw sugar in Queensland for 1932 was 514,027 tons of 94 n.t., as compared with 581,276 tons produced in 1931. Yields in the Northern area were favourable, but prolonged drought conditions in the Southern districts resulted in an almost complete crop failure in those parts. The entire cane tonnage harvested south of Mackay amounted to only 208,600 tons, which is less than the crop treated by one of the larger Northern mills.

The following table shows the amount of cane which was crushed by the mills in 1932 :—

Mills.	Tonnages Crushed 1932 Season.
Mossman	106,612
Hambledon	207,428
Mulgrave	219,926
Babinda	207,146
Goondi	164,667
South Johnstone	237,945
Mourilyan	168,179
Tully	259,526
Victoria	234,756
Macknade	247,846
Invicta	77,931
Pioneer	129,069
Kalamia	170,757
Inkerman	167,950
Proserpine	123,380
Cattle Creek	60,426
Racecourse	96,028
Farleigh	100,162
North Eton	41,274
Marian	97,976
Pleystowe	99,002
Plane Creek	119,866
Qunaba	did not crush.
Millaquin	*27,632
Bingera	27,237
Fairymead	53,031
Gin Gin	5,166
Childers	8,965
Isis	†17,719
Maryborough	7,228
Mount Bauple	did not crush.
Moreton	52,001
Rocky Point	8,566
Eagleby	1,046
Total	3,546,443

The total area harvested in 1932 was 205,046 acres, which is the lowest since 1927. The reduction from 1931 was 27,898 acres. The tonnage of cane per acre crushed was 17·30, which was slightly higher than the 1931 figure of 17·29 tons.

* Including cane from Qunaba. † Including cane from Mount Bauple.

General—continued.

The yields of cane and sugar per acre in the different sugar districts were as under :—

Acreage Yields by Districts.

District.	Tons Cane per acre.	Tons 94 N.T. Sugar per acre.
Mossman to Ingham	21·38	3·11
Lower Burdekin District	23·66	3·68
Proserpine	11·99	1·68
Mackay to St. Lawrence	12·11	1·76
Bundaberg, Gin Gin, &c.	7·44	0·79
Maryborough, Childers, &c., to Gympie	6·67	0·75
Nambour and Beenleigh	14·88	1·89
State Average	17·30	2·51

In his 1932 Report, the Registrar-General shows the average acreage grown by cane-planters in Queensland to be as follows :—

	Acres.
Cairns to Townsville	54
Ayr to Mackay	45
Bundaberg to Bauple	27
Maroochy (Nambour) to Beenleigh	11
Average	40

This brings the average area per farmer to 40 acres, which is 2 acres lower than the previous year.

The tons of cane required to make a ton of 94 net titre sugar were 6·90. This figure was the lowest but one ever recorded in Queensland. The record low value was 6·83 tons in 1930. The marked improvement in this figure in recent years is due in part to each of the following factors :—(*a*) The cultivation of varieties richer in sugar than the older canes ; (*b*) improved milling recoveries ; and (*c*) increased milling rates, enabling the crushing season to be reduced and the harvesting of the cane to be carried out as nearly as possible at its peak of maturity.

The following table gives the crop statistics for Queensland during the past ten years : —

Table showing Acres Cultivated and Harvested, Yields of Cane and Sugar, Acre-Yields, and Quality of Cane, 1923–1932.

Year.	Acres Cultivated.	Acres Harvested	Total Yields.		Yields Per Acre.		Tons Cane to 1 Ton Sugar.
			Cane.	Sugar.	Cane.	Sugar.	
			Tons.	Tons.	Tons.	Tons.	
1923	219,965	138,742	2,045,808	269,175	14·75	1·94	7·60
1924	253,519	167,649	3,171,341	409,136	18·92	2·44	7·75
1925	269,509	189,466	3,668,252	485,585	19·36	2·56	7·55
1926	266,519	189,312	2,952,662	389,272	15·45	2·06	7·52
1927	274,838	203,748	3,555,827	485,745	17·45	2·38	7·32
1928	283,476	215,674	3,736,311	520,620	17·32	2·41	7·18
1929	291,660	214,880	3,581,265	518,516	16·67	2·41	6·91
1930	296,070	222,044	3,528,660	516,783	15·89	2·33	6·83
1931	309,818	233,304	4,034,360	581,276	17·29	2·49	6·94
1932	291,136	205,046	3,546,443	514,085	17·30	2·51	6·90
10 Years' Average					17·04	2·45	7·25

General—continued.

In 1932 the ten mills north of Townsville produced 299,343 tons of sugar, while the twenty-three south of Townsville produced 214,472 tons.

MAFFRA BEET FACTORY.

During the past season the Maffra Sugar Factory, Victoria, manufactured 5,701 tons of sugar from 35,438 tons of beets. The average yield of beets per acre was 11·6 tons, and the average sucrose content of the beets was 19·25 per cent.

SUGAR VALUES.

The proportion of the sugar manufactured in Queensland which was required for consumption and use in the Commonwealth of Australia was declared at 65·4828 per cent., and that for export at 34·5172 per cent. These proportions are exclusive of the "excess" sugar manufactured from cane grown on "unassigned" lands and that produced by mills in excess of their allotments under the "peak" year scheme. The "excess" sugar produced for the season was 23,108 tons, as compared with 21,660 tons for the 1931 crop.

The price payable for the sugar for consumption and use in Australia was declared at £25 2s. 3d. per ton of 94 net titre, a reduction of £1 16s. 9d. on the home consumption price of the previous season. This was due to the reduction of ½d. per lb. in the retail price of refined sugar as from 5th January, 1933. The exported sugar netted £8 5s. 9d. per ton of 94 net titre.

The average price paid to those Queensland mills which did not produce "excess" sugar was £19 6s. 1d. per ton of 94 net titre, compared with £18 6s. 6d. for the 1931 crop. The increased price was a natural consequence of the reduced yields, due largely to the almost complete failure of the crop in Southern Queensland.

The following figures show the values received by the industry per ton of 94 net titre sugar since 1923 :—

Year.	Price received. £ s. d.
1923	27 0 0
1924	26 0 0
1925	19 10 7
1926	24 10 10
1927	22 0 4
1928	20 17 11
1929	20 5 10
1930	19 13 1
1931	18 6 6
1932	19 6 1

The quantities of raw sugar which have been exported since 1924 (when the first large surplus was produced) and the price received therefor are as follows :—

Year.	Tons Bagged Sugar.	Price per ton. £ s. d.
1924	74,000	21 0 0 (approx.)
1925	219,000	11 5 9
1926	74,777	14 18 10
1927	152,384	12 2 6
1928	186,703	10 10 0
1929	197,000	9 17 0
1930	203,605	8 5 0
1931	291,802	9 7 0
1932	189,733	8 5 9

The total value of the 1932 crop was £10,080,000.

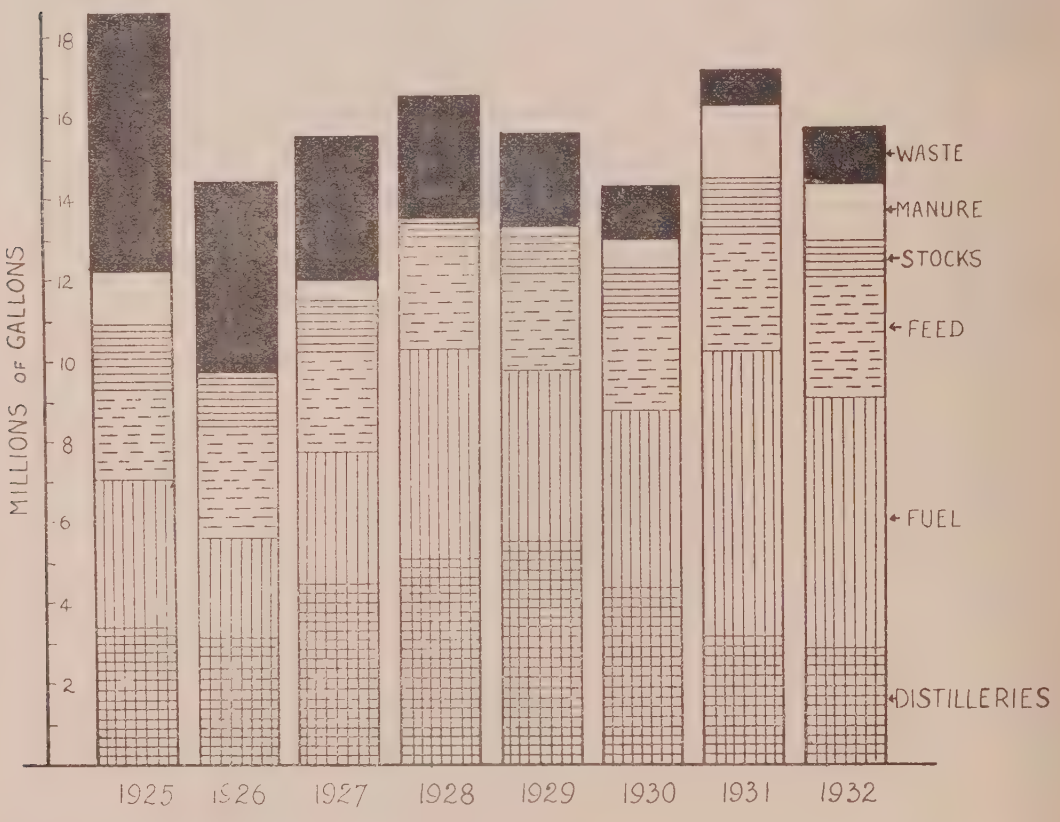
General—continued.

MOLASSES PRODUCED.

The following figures supplied by the Registrar-General show the manner in which the molasses produced in 1932 was disposed of :—

	Gallons.
Sold to distilleries	2,796,120
Burnt as fuel	6,182,769
Used or sold for feed	2,988,905
Sold for other purposes	108,122
In stock	898,524
Used as manure	1,414,338
Run to waste	1,402,483
	15,791,261

A summary of the molasses statistics for the past eight years is represented by the accompanying graph. It should be observed that the industry is attempting to utilise this by-product to the best advantage, and, far from being a "waste" product, it is put to many valuable uses.



Graph showing the manner in which molasses has been disposed of, 1925-1932.

A steady increase in molasses used for the production of alcohol is observed until 1929, when the general economic situation saw a reduction in the consumption of spirituous liquors and industrial alcohol, while heavy stocks of spirit had accumulated.

The years 1931 and 1932 showed a marked increase in the quantity of molasses utilized by the mills as fuel. It is claimed that, in addition to its own calorific value, the application of a proportion of molasses to the final bagasse improves its burning qualities, thus enhancing its value as a fuel. By the adoption of these economies, many mills have almost completely eliminated the need for extraneous fuel, and in one or two instances surplus bagasse is available.

General—continued.

The volume of molasses used by farmers as stock feed has shown a steady increase, and it is interesting to observe the growing appreciation of the value of this by-product as a manure. It is anticipated that the 1933 figures will reveal a further large increase over the 1932 data.

The quantity run to waste was reduced from 6,278,000 gallons in 1925 to the record low figure of 910,000 in 1931, which represents but 5·25 per cent. of the total production.

In all probability this quantity would have been put to better use but for the transportation difficulties which in certain new areas greatly handicap the transference of this material to the fields.

THE ECONOMIC OUTLOOK.

The present Australian estimate shows that approximately 649,000 tons of sugar will be manufactured from cane this year. If this be realised, the yield will exceed the previous record of 1931 by some 44,000 tons. The Queensland industry is thus faced with the prospect of exporting practically one-half of its crop. The price declared for home-consumed raw sugar is £24 per ton, while there is little likelihood that the net export value will exceed £8. The average price paid for *all* sugar will, therefore, be in the neighbourhood of £16 per ton of 94 net titre, which is the lowest since 1914.

The situation is a serious one. It is obviously highly uneconomical for the Queensland producer to sell his product at £8 per ton. This value is far below the cost of production, and indeed it is doubtful whether any country could produce sugar profitably at that figure. It has been the fond hope of all exporting countries that the reduction in world supplies during the past two or three years would provide relief by forcing up values. But the market remains lifeless, and the future is obscured by uncertainty. The Chadbourne Agreement which was entered into in 1930, following a conference of the more important exporting countries, was designed to restrict production and provide for the gradual absorption of the heavy accumulation of surplus sugar. Unfortunately, the results of the plan have not been satisfactory. Those countries outside the plan have continued to increase their production, and world consumption figures have been adversely affected by the general economic conditions.

In an attempt to secure more adequate control of the entire world situation, Cuba, as one of the principal supporters of the Chadbourne Plan, submitted proposals for a drastic agreement to a sub-committee of the World Economic Conference which was held in London during the current year. Though the proposals were not adopted, it was agreed that the position demands immediate attention, and there was a move on the part of the signatories to the Chadbourne Plan to extend the operations of such an agreement to all exporting countries. However, the Conference eventually closed without any finality being reached for the stabilisation of prices or the restriction of output.

Meanwhile the continued restriction of production in Cuba, coupled with deflated values, has led to a profound political upheaval in that country, and it is anticipated that demands will be made for an early restoration of unrestricted plantings. Recent developments in white sugar production in India, under the protection of an almost prohibitive tariff, have cut off the outlet for a large proportion of the export sugar from Java, and it is confidently anticipated that at the present rate of increase in production India will be in a position to export sugar by 1935.

These facts are advanced to show the serious position which confronts the world's sugar industry, and which is responsible for the present low prices and lack of confidence in the future of the commodity. There is thus little hope that an immediate recovery in values will render the export of surplus sugar a profitable venture for the Queensland producer; and long before that level is reached countries such as Java and Cuba will be in a position to take full advantage of the improved conditions. It is reported that Java, for instance, has planted this year in anticipation of a 500,000-ton sugar crop, whereas the normal production of that country is in the vicinity of 3,000,000 tons.

General—continued.

The remedy for Queensland's trouble is obvious; but the formulation of a generally acceptable plan to give effect to any restriction proposals is a most difficult matter. That the problem will be attacked in all earnestness is certain, for, following on the record tonnages of 1933, all sugar areas have been favoured with beneficial late spring rains, and the young crop is particularly well advanced. Given a continuance of reasonably favourable conditions, there is every likelihood that an even heavier crop than the present one will be recorded in 1934.

It is hoped, however, that the leaders of thought in the industry will keep clearly in mind the necessity for a sound economic foundation for the structure they will raise. It has been claimed that the past restrictive measures which were formulated on an acreage basis have failed to effect the desired purpose, as growers have been inspired to produce greater crops on reduced areas. This might, on the contrary, be advanced as the soundest argument in favour of the scheme. It has forced growers to the appreciation of the fundamental fact that in this country, at least, intensification of cultivation leads to a reduction in production costs and the creation and maintenance of a state of high fertility in the soil.

In assessing production costs, the factor of land depreciation is one which is too often overlooked; indeed, it is freely agreed by many farmers that new land must of necessity deteriorate with cultivation. The fallacy of this statement has been demonstrated repeatedly by certain of our progressive farmers who are to-day producing crops greatly in excess of those harvested from the land in its virgin state, but it can be done only by the adoption of sound agricultural practices, and, above all, by the employment of the heavy dressings of artificial manures which the natural poverty of the average Queensland cane soil demands. Applications of from 10 to 15 cwt. of fertilizer per acre are now made as a regular practice by many growers, and, paradoxical though it may appear, it is confidently suggested that the intensive production which is responsible for many of the industry's ills is one of the most reassuring features of the present outlook. The difficulty lies in the fact that too many acres have been brought under cultivation.

Alternative restriction plans have been proposed which seek to limit each grower to a definite tonnage allocation. Though this plan appears to be most simple in formula, it is felt that the net effect may prove highly disastrous if adopted independently of any acreage limitations. It offers no incentive whatsoever to progressive agriculture; it tends to penalise efficiency and to impose a handicap on those growers who are striving to rejuvenate the older soils, many of which have already been the objects of much abuse in the past. This aspect of the rationalisation plan cannot be overlooked; if it is to survive, the industry must go forward, and not retrogress.

Work of the Bureau.

The past year's work marks further progress along the general lines indicated in previous reports. The detailed statements of the officers of the various Divisions are recorded in the subsequent pages of this Report, while the following summary embraces some of the more important aspects of the year's accomplishments.

Staff.

In April last the writer was appointed Director, as successor to the late Mr. H. T. Easterby. The Director now combines the duties of Chemist and Agriculturist with those of general administration.

The acute position which exists with respect to the extension and field investigational services was relieved to some extent by the appointment during the year of Mr. G. A. Christie as Cadet. This officer has spent periods of training in the Head Office laboratories, has assisted in the plant-breeding work at South Johnstone, and has become acquainted with field experimental and advisory duties in association with the field officers of the Bureau. In this way the officer was afforded an opportunity of gaining a general insight into the major activities of the organisation, and of studying the cultural methods employed in the several important cane districts of the State. He will now be attached to the Sugar Experiment Station at Bundaberg, where he will receive further training to fit him eventually for the position of field officer.

In order that the duties of our extension service might be effectively performed it will be necessary to increase the personnel to six officers. At present there are only two such assistants on the staff, although similar duties are performed in part by other officers.

The services of Mr. N. J. King, as Soils Surveyor, have been continued throughout the year, and it is most desirable that he be appointed permanently to the staff. His investigations on the soils of the Bundaberg area have given us a much clearer understanding of the problems associated with canegrowing in the drier areas of the State, and it is hoped that these studies may be extended to other major districts. The results of his recent investigations will be issued in bulletin form at an early date.

The work of the Division of Mill Technology is sadly hampered by the inadequacy of staff. While it is difficult to secure the services of a competent Mill Technologist to assume control of the work, it is felt that the position could be relieved considerably by the appointment of a further assistant.

Advisory Committee.

At the request of the Honourable the Secretary for Agriculture and Stock, a committee was appointed by the industry during the past year to act in an advisory capacity. The committee is constituted as follows :—

Millers' nominee—Mr. J. Smith,

Growers' nominees—Messrs. W. D. Davies and B. Courtice,

Technologists Society's nominee—Mr. W. F. Seymour-Howe,

And the Director,

with the Honourable the Minister for Agriculture as chairman.

The first meeting of the committee was called in July last, when matters affecting the Bureau were frankly discussed, and certain recommendations made to the Minister.

It is proposed to hold meetings of this nature as circumstances demand, and the industry doubtless appreciates this action of the Minister in seeking its advice on important sugar matters.

Work of the Bureau—continued.

Quarterly Publication.

In July, the first number of a new publication was issued in an attempt to bring growers into more intimate contact with the work of the Bureau. The *Cane Growers' Quarterly Bulletin* will be issued regularly, and a copy posted direct to each canegrower of the State. It is pleasing to note that the venture has been received most favourably by the industry.

Seedling Work and Disease Control.

The report of the Plant Breeder shows that a considerable expansion has taken place with respect to the propagation of new varieties. At the present time approximately 25,000 seedlings are raised annually, and this number will be increased as the work progresses. It will be observed from the report of the Pathologist that this project goes hand in hand with disease-resistance trials, and the results to date suggest that the technique which is being developed to determine resistance of new seedlings to the major diseases of the State must place the work on a much firmer foundation than has been the case hitherto.

Recently, an area of three acres of Crown land—R. 178, parish of Smithfield—was transferred to this Bureau by request for use as a cross-pollination substation. The work of the past three years at South Johnstone and Freshwater shows that the latter area is much superior to the older Station for this purpose, and the Bureau is fortunate in securing an area so suitably placed for permanent work in the Freshwater district. Steps have been taken to provide accommodation on the reserve for the equipment employed in the work, and the increased facilities should ensure an abundance of good seed for future propagation.

It is pleasing to note that one of our earlier seedlings—S.J. 4—is coming into prominence in the Northern areas. It is hoped that on the poorer lands in those parts it may prove superior to the old standards—D. 1135, B. 147, and Pompey. Because of its lower sugar content it has never been recommended as an alternative for Badila, and should, therefore, not be planted on the best lands. During the past season several hundreds of acres were planted to S.J. 4.

A very commendable piece of research was finalised by the Pathologist and Assistant Entomologist at Bundaberg during the past year, when they were able to determine conclusively the insect vector responsible for the transmission of Fiji disease. This knowledge was essential before adequate control measures could be suggested for the elimination of the disease by plant selection. Similar studies are now being extended to other major diseases of the State.

Farm Experimental Plots.

The farm fertility trials of the past year have provided further valuable information concerning the plant-food deficiences of the major soil types. Growers are evincing a very keen interest in the work, and there can be no doubt that the lead which the results of this work has given them concerning the precise nature of their soil deficiencies has been responsible in no small measure for the marked increases in crop yields observed in many areas during recent years. The project would be pursued on a more intensive scale than is possible at present if the desired extension service personnel were available.

The results obtained each year show in no uncertain manner just how deficient in plant-foods the Queensland cane soils are, and the necessity for intensive cultivation—which embraces very heavy fertilizer applications—if the yields of cane are to remain at a profitable level. No better example of this aspect of manuring can be given than the yields of a trial harvested at South Johnstone Station last year. For a second ratoon crop of Badila the results were :—

Adequately fertilized	36·5 tons of cane per acre.
Unfertilized	17·4 tons of cane per acre.

Work of the Bureau—continued.

In the course of but three years the productivity was reduced by over 50 per cent. below that of the fertilized land.

Similar results are being recorded from the farm plots; the detailed report of the year's work will be found in the January, 1934, number of the *Cane Growers' Quarterly Bulletin*.

Although it is in the areas of more regular rainfall distribution and those where irrigation is practised that the results are most outstanding, the return to better seasons in the Mackay and Southern areas is demonstrating similar facts for these centres. There is no doubt but that the depletion of fertility over a number of years contributes as much to reduced yields in bad seasons as does the lack of soil moisture.

New experiments have been initiated during the year on the following farms, and more will be undertaken in the Central and Southern areas before the close of the season.

Farm Trials, 1933.

Northern Division.

H. Crawford, Mossman
R. D. Rex, Mossman
Lyons Bros., Freshwater
D. Jones, Edmonton
W. Chapman, Hambledon
R. Hansen, Highleigh
B. Murray, Meringa
Walker Estate, Meerawa
C. T. Neilsen, Harvey Creek
T. Jones, Feluga
Mullins Bros., Tully

Central Division.

Griggs Bros., Giru
R. D. Low, Jarvisfield
J. Casalegno, Kalamia
Hoey Bros., Pioneer
J. Ahern, Airdale
E. Lewty, Dick's Bank
Ferguson Bros., Ayr
Tyler and Sons, Orkabie
Garnham Bros., Mount Martin
C. Gohdes, Racecourse

Southern Division.

L. Zielke, Sandhills road, Bundaberg
W. Kirby, Rubyanna, Bundaberg
A. W. Bates, South Kolan

We would again express our keen appreciation of the assistance afforded us by the growers who have undertaken the work on our behalf, and also to the following fertilizer companies who have supplied our entire requirements of fertilizer for these investigations :—

A.C.F. and Shirley's Fertilizers, Limited;

Nitrogen Fertilizers Pty., Limited;

Pacific Potash Limited

Training and Research Facilities.

It is regretted that lack of laboratory space does not permit of an extension of the service which it is felt the Bureau might provide for the industry in supplying accommodation and equipment for scientific workers to carry out such research in the slack season as is not possible at their mills. The excellent library facilities which are provided at the Brisbane Laboratory might also be availed of in this way. During the past year it was possible, however, to take in three agricultural men associated with the larger plantations for a period of training in pathological and soil analytical work. In addition, certain of the senior students of the Sugar Diploma Course at the Technical College have availed themselves of the facilities presented for study and investigational work.

Work of the Bureau—continued.

New Implements.

During the year an implement new to Queensland was imported from Hawaii through the courtesy of the Onomea Sugar Company. This machine is known as the "Stubble Shaver," and during its trials has been favourably commented on by canegrowers, particularly those in the irrigated areas. Where the cane row has been hilled up it affords a simple and economical means of reducing the land surface to its original level condition prior to ratooning. Certain firms are now manufacturing similar implements in Queensland.

Little has been heard of the cane harvester of late, though it is reported that an improved model of the "Howard" is being tried out by the Fairymead Sugar Company.

Balance Sheet.

STATEMENT OF RECEIPTS AND DISBURSEMENTS FROM 1st JULY, 1932, TO 30th JUNE, 1933.

Receipts.	£	s.	d.	Disbursements.	£	s.	d.	£	s.	d.
To Balance, 1st July, 1932	13,053	4	0	By Salaries				6,328	9	9
				,, Contingencies—						
To Assessments	7,389	8	6	Salaries and Wages	1,249	8	0			
,, Endowment	5,911	10	10	Travelling Expenses, Hires, Fares, Freights, Allowances	1,567	11	9			
,, Bundaberg Station	102	3	11	Apparatus, Furniture, Books, Installations ..	1,044	17	6			
,, Mackay Station	320	18	9	Printing, Advertising, Stationery	490	17	3			
,, Johnstone Station	1,416	3	6	Laboratory Shed, &c., Domain ..	164	12	5			
,, Gordonvale Station	89	8	5	General Expenses	434	10	6			
,, Sundries	37	14	6					4,951	17	5
				,, Bundaberg Contingencies				975	6	3
				,, Mackay Contingencies				1,305	9	6
				,, Johnstone Contingencies				1,858	10	11
				,, Gordonvale Contingencies				998	9	5
				,, Balance, 30th June, 1933				11,902	9	2
	£28,320	12	5					£28,320	12	5

C.C.S. Formula.

For the benefit of foreign readers of this report the formula used for arriving at the commercial cane sugar (C.C.S.) in Queensland cane is given below :—

$$C.C.S = \frac{3P}{2}\left(1 - \frac{5+F}{100}\right) - \frac{B}{2}\left(1 - \frac{3+F}{100}\right)$$

where—P = pol. in first expressed juice
B = brix in first expressed juice
F = fibre in cane.

Division of Soils and Agriculture.

The work of the past year on the Experiment Stations and the private farms on which experimental plots are located has yielded further valuable information and improved our knowledge of the various factors which are instrumental in reducing tonnage yields and obstructing efforts to reduce the costs of production. It is gratifying to record that growers in many areas are so appreciative of the results obtained during recent years that we are rather embarrassed with the numerous requests for experimental blocks.

Progressive returns from the trials located on the South Johnstone Station indicate fairly clearly the nature of the optimum fertilizer treatments for the acid alluvial soils of that area, and at the present time the following would appear to approximate to the limits :—

Sulphate of ammonia	200-600 lb. per acre
Superphosphate	900 lb. per acre
Muriate or sulphate of potash	150 lb. per acre
Total	1,250-1,600 lb. per acre

All crops would receive the full amounts of phosphate and potash, while the nitrogen application would depend on the nature of the crop ; for plant cane following green manuring with a legume crop the lower limit would suffice ; with old ratoons, the full 600 lb. dressing would be necessary.

Quantitative trials on the red volcanic soils, on the other hand, show the definite need for heavy applications of potash. Thus, at Bartle Frere, 500 lb. per acre of muriate of potash, combined with relatively smaller amounts of superphosphate and sulphate of ammonia, are found to promote markedly improved crop growth. A first-ratoon crop treated in this manner during the past season yielded over 37 tons of cane per acre, whereas the normal average crop is about 20 tons, even with the average fertilizer treatment. Farmers are thus growing to appreciate the need for selecting just that mixture which is best suited to their special requirements, and the benefits from fertilizers are increasing accordingly.

Soil Survey.

The soil survey project of the past year was confined exclusively to an intensive study of the soils of the Bundaberg area and their moisture relationships, with special reference to the red volcanic type. The results have been most valuable and show very definitely the fundamental weaknesses of this class of soil under non-irrigated conditions. The need for special deep-rooting cane varieties has been definitely proven, while the adoption of practices designed to improve the moisture-holding capacity of the soil and increase its fertility cannot be too strongly urged.

Trash Conservation.

In pursuance of the latter aspect of the problem, the conservation of cane trash undoubtedly offers the most promising field. Experimental blocks with this material have been instituted on each of our stations, and it is proposed to continue the treatments over a period of years to determine the cumulative effects. The plots have now been planted for their first crop.

The problem of mechanical handling of these crop residues is one which has been given very careful attention, for doubtless the cost of trash-handling operations has discouraged many growers from adopting the practice. The modified hay rake and the side-delivery rake have been tried out, and it appears that each of these may be used successfully. Figures obtained in Bundaberg during the year have clearly demonstrated the value of trash as a surface mulch, while the final incorporation of the rotted material in the soil, when the old ratoons are ploughed out, enables full advantage to be taken of this useful crop residue.

Division of Soils and Agriculture—continued.

Variety Trials.

The results from trial plots of P.O.J. 2878 during 1933 were of a mixed character In the Northern areas the new variety has proved disappointing, chiefly due to its late maturing characteristics and its susceptibility to Red Stripe disease. Early planting would minimise these effects, but this practice is not always possible in the humid areas. In the Burdekin district, the susceptibility of the variety to Downy Mildew disease is a serious consideration. In the Southern areas, however, this new cane shows very decided promise. Its high resistance to Gumming disease, its ability to withstand drought, its vigour of growth and strong ratooning qualities are all in its favour, and, although its late-maturing habit is again evident, this should not prevent the extension of planting to embrace from 25 to 30 per cent. of these areas.

Certain other of the Javan varieties have this year been submitted to farm varietal trials. Of these, P.O.J. 2725 appears to possess decided promise and, having in mind its early maturity, it may supply a long-felt want in those districts where adverse seasons are the rule. The earlier results with this and other varieties are found under the report of the Bundaberg Experiment Station.

Maturity Testing.

This project has been the subject of further intensive studies during the past season, and it is now felt that suitable methods have been developed to make the scheme both reliable and practicable. A survey of our studies along these lines will appear shortly as a bulletin.

Wireless Lectures.

A series of wireless lectures was delivered during the past winter months, and these were eventually printed in the *Cane Growers' Quarterly Bulletin*.

Laboratory Work.

General analytical work is now undertaken at South Johnstone, Mackay, and Brisbane. In the laboratories located at headquarters, work of a specialised nature is added to that of general routine tests. Following on a four-year test of our soil analytical methods as against the field response determined in farm fertility trials, the comparative returns are now being reviewed to estimate the value of laboratory determinations. There is every reason to believe that the simpler chemical tests, adequately correlated with field experience, will afford a useful adjunct to the direct experimental method.

Further large numbers of irrigation waters were tested, showing the interest which growers are taking in this aspect of intensive cultivation, and in the need for keeping a close watch on the quality of those from areas where the concentration of injurious salts is likely to become dangerous.

The following is a summary of the analyses performed at the Brisbane Laboratory for the year ended 31st October, 1933 :—

Summary of Analytical Work for the Year 1932-33, Brisbane Laboratory.

	No. of Samples.
Soils	218
Waters	101
Sugar-canes	23
Green manures and plant materials	22
Biological media	21
By-products	23
Lime and fertilizers	11
Sugars	6
Miscellaneous	11
Total	436

Work of the Experiment Stations.

Reports prepared by the Chemists in charge of the three stations will be found in the following pages, together with a summary of the year's work in seedling propagation by the Plant Breeder.

SEEDLING PROPAGATION.

E. J. R. Barke, Cane Breeder.

The cross pollination work was again carried out at the Northern Sugar Experiment Station, South Johnstone, and at the Freshwater Sub-station, Cairns.

The weather conditions which prevailed during the past crossing season in the South Johnstone and Freshwater districts were markedly different, and offered a striking example of the susceptibility to environmental conditions of arrowing and fertility of arrows. At South Johnstone the rainfall was above the average, the percentage of arrowing greater than is usually experienced, and the amount of viable pollen high. These conditions were also reflected in the seed germinations, which were higher per arrow than in any previous year. The rainfall in the Freshwater district, previous to and during the cross pollination period, was low; the degree of arrowing was 45 per cent. of that of the previous season, and the pollen was often malformed and of low fertility. The *S. officinarum* varieties were affected to a greater extent than was the case with canes of *S. spontaneum* blood, and this was also true in regard to the setting of fertile seed.

The number of trial marriages effected this year amounted to seventy-two, and these are set out in the table hereunder :—

Crosses carried out during the Breeding Season, 1933—South Johnstone and Freshwater.

Female.	Male.
Badila	Glagah (*S. spontaneum*), S.C.12 (4), *S. robustum*, E.K. 28, P.O.J. 2878, P.O.J. 2940
N.G. 16	*S. robustum*, S.C. 12 (4), Q. 813, H.Q. 409, P.O.J. 2878, P.O.J. 2940
N.G. 24	S.C. 12 (4), Q. 813
P.O.J. 213	W. 4, H. 1541
P.O.J. 2364	P.O.J. 2878, P.O.J. 2940, H.Q. 409, D. 1135
P.O.J. 2722	Ewa 371, H.Q. 409, W. 4, S.C. 12 (4), H. 1541, P.O.J. 2940
P.O.J. 2725	S.C. 12 (4), S.W. 499, S.J. 3c, Co. 281, S.J. 2f, S.J. 142d, D. 1135
P.O.J. 2878	P.O.J. 2940, S.C. 12 (4), S.J. 1c, S.J. 2c, S.J. 3c, S.J. 6c, S.J. 88c, D. 1135, H. 2265, S.W. 499, W. 4, M. 189, Ewa 371, H.Q 409
Co. 281	E.K. 28
U.D. 1	E.K. 28
U.D. 110	S.J. 1c
Zwinga	S.J. 1c, S.J. 3c
S.J. 14a	S.C. 12 (4)
U.D. 75	S.J. 3381c
S.J. 4	S.C. 12 (4), P.O.J. 2940
S.J. 4c	28 N.G. 251
M 189	S.C. 12 (4)
S.J. 146d, S.J. 172d, S.J. 188d, S.J. 194d, S.J. 198d	S.J. 2c
Oramboo	S.C. 12 (4), Q. 813
H.Q. 409	S.C. 12 (4)
S.J. 182d	H.Q. 409
B. 208	S.C. 12 (4)
B. Cheribon	S.C. 12 (4)

Seedling Propagation—continued.

Selections from 1932 Crossings.

The following table gives the percentages of seedlings selected from the different trial marriages :—

Parents. ♀ ♂	Selected.	Average Brix.
	Per cent.	Per cent.
Badila × D. 1135	Nil	17·8
Badila × S.C. 12 (4)	1·8	21·6
Badila × Q. 813	8·0	21·8
Badila × H.Q. 409	0·05	20·1
Badila × Kassoer	30·0	*
Badila × *S. robustum*	14·0	*
Badila × P.O.J. 2878	3·1	21·1
Badila × P.O.J. 2940	0·02	20·2
Badila × W. 4	Nil	18·7
N.G. 16 × D. 1135	Nil	18·1
N.G. 16 × S.C. 12 (4)	0·03	21·0
N.G. 16 × W. 4	Nil	18·6
N.G. 16 × Ewa 371	0·01	20·2
N.G. 16 × H.Q. 409	0·08	20·9
N.G. 16 × Q. 813	2·5	21·6
N.G. 16 × P.O.J. 2878	2·0	21·1
N.G. 16 × P.O.J. 2940	0·02	20·2
N.G. 24 × S.C. 12 (4)	2·1	22·1
N.G. 24 × W. 4	0·2	20·4
N.G. 24 × Ewa 371	Nil	18·9
N.G. 24 × R.P. 8	Nil	19·5
N.G. 24 × S.J. 3	Nil	21·6
P.O.J. 213 × H.Q. 409	0·01	21·2
P.O.J. 213 × D. 1135	Nil	20·0
P.O.J. 2364 × Badila	1·2	19·9
P.O.J. 2364 × D. 1135	Nil	17·8
P.O.J. 2364 × H.Q. 409	5·2	20·8
P.O.J. 2364 × S.J. 4	Nil	16·7
P.O.J. 2722 × S.C. 12 (4)	0·07	20·2
P.O.J. 2878 × P.O.J. 2940	25·0	21·7
P.O.J. 2878 × S.C. 12 (4)	4·2	21·9
P.O.J. 2878 × S.J. 102c	2·0	21·7
P.O.J. 2878 × S.J. 32d	0·05	20·9
Co. 227 × S.C. 12 (4)	0·2	20·5
Co. 227 × D. 1135	Nil	18·8
B. Cheribon × S.C. 12 (4)	1·5	20·2
B. Cheribon × Ewa 371	Nil	18·6
B. Cheribon × S.J. 298d	2·0	20·0
B. Cheribon × *S. robustum*	4·0	*

* Breeding purposes only.

Seedling Propagation—continued.

Parents.	Selected.	Average Brix.
	Per cent.	Per cent.
Uba × S.C. 12 (4)	Nil	†18·2
R.P. 6 × S.C. 12 (4)	2·0	21·8
R.P. 6 × S.J. 1D	2·0	21·7
M.Q. 1 × S.C. 12 (4)	Nil	18·0
M.Q. 1 × P.O.J. 2878	Nil	17·2
7 R. 428 × Badila	2·6	21·8
P.O.J. 2725 × H.Q. 409	2·0	21·2
Oramboo × S.C. 12 (4)	2·5	22·1
Oramboo × Q. 813	5·2	21·9
Oramboo × H.Q. 409	19·0	23·2
Oramboo × Kassoer	2·4	21·2

† Runts.

The Oramboo x H.Q. 409 progeny gave the most outstanding juice-quality results, and in one instance a c.c.s. of 22·8 per cent. was obtained.

Second Selections of 1931 Seedlings.

The second-year selections of the 1931 seedlings were carried out during the months of June, July, and August, and thirty-seven canes were chosen. The examinations during June and July comprised chiefly juice analysis, while in August juice analysis, weight of stools, disease-resistance, and general habits were studied.

The results of the selected seedlings are set out below :—

Seedling.	Parents.	C.C.S.	Weight per Stool.
		Per cent.	Lb.
1D	P.O.J. 2940 × S.C. 12 (4)	14·5	36
2D	P.O.J. 2940 × S.C. 12 (4)	14·2	37
3D	P.O.J. 2940 × S.C. 12 (4)	14·8	34
4D	P.O.J. 2940 × S.C. 12 (4)	15·2	32
5D	P.O.J. 2878 × S.C. 12 (4)	15·1	29
6D	P.O.J. 2878 × S.C. 12 (4)	14·9	32
7D	P.O.J. 2878 × S.C. 12 (4)	15·4	28
8D	P.O.J. 2878 × S.C. 12 (4)	14·3	29
9D	P.O.J. 2878 × S.C. 12 (4)	14·5	27
10D	P.O.J. 2878 × S.C. 12 (4)	14·1	34
11D	P.O.J. 2878 × S.C. 12 (4)	15·2	28
12D	P.O.J. 2878 × S.C. 12 (4)	13·8	38
13D	P.O.J. 2878 × S.C. 12 (4)	14·5	29
14D	P.O.J. 2878 × S.C. 12 (4)	14·8	26
15D	N.G. 24 × S.C. 12 (4)	15·9	34
16D	N.G. 15 × S.C. 12 (4)	16·8	26
17D	N.G. 15 × S.C. 12 (4)	16·7	28
18D	N.G. 15 × Q. 813	16·2	23
19D	N.G. 15 × Q. 813	16·4	22
20D	N.G. 15 × Q. 813	15·7	28
21D	N.G. 15 × Q. 813	15·9	26

Seedling Propagation—continued.

Seedling.	Parents.	C.C.S.	Weight per Stool.
		Per cent.	Lb.
22D	N.G. 15 × Q. 813	16·2	24
23D	N.G. 15 × Q. 813	15·8	24
24D	S.J. 4 × R.P. 6	14·7	31
25D	Oramboo × E.K. 28	14·5	26
26D	Oramboo × E.K. 28	15·7	22
27D	Oramboo × E.K. 28	15·4	28
28D	Oramboo × E.K. 28	15·6	24
29D	Oramboo × E.K. 28	16·1	22
30D	Oramboo × S.C. 12 (4)	16·2	31
31D	Oramboo × S.C. 12 (4)	16·0	25
32D	Oramboo × S.C. 12 (4)	16·2	23
33D	Oramboo × S.C. 12 (4)	15·7	31
34D	Oramboo × S.C. 12 (4)	15·8	28
35D	Oramboo × S.C. 12 (4)	15·8	26
36D	Oramboo × S.C. 12 (4)	16·3	25
37D	Oramboo × S.C. 12 (4)	15·9	31

Second Nobilization of S. spontaneum and S. robustum.

The second nobilization of *S. spontaneum* and *S. robustum* with our standard variety (Badila) has yielded a number of vigorous and large-stooling canes. The sucrose content is rather disappointing, but it is hoped that the third nobilization, which has been carried out this year, will considerably increase this factor.

Inter-generic Crosses.

No further inter-generic crosses have been carried out, as the only available species of Erianthus has produced all low-vigour progeny when crossed with *Saccharum spontaneum* and *Saccharum officinarum*.

Seedling Work at Mackay and Bundaberg.

Of the 5,000 seedlings grown at Mackay during the 1932 season, 97 were selected. The most outstanding canes were progeny from the following crosses:—P.O.J. 2878 x S.C. 12 (4), N.G. 24 x S.C. 12 (4), N.G. 24 x Ewa 371, Pompey x D. 1135, and N.G. 16 x P.O.J. 2878.

A second selection of the 1930 and 1931 seedlings resulted in 22 being chosen. They were chiefly combinations of P.O.J. 2878 and S.C. 12 (4).

This year 5,000 to 6,000 seedlings are being planted in the field, and these will include a number with *S. robustum* and *S. spontaneum* blood.

On account of the prolonged drought, the first selection of the 1930 and 1931 seedlings was made at Bundaberg this year, and 35 were retained. The most promising combinations were Oramboo x S.C. 12 (4), N.G. 24 x R.P. 6, and S. J. 4 x S.C. 12 (4).

Of the 3,060 seedlings grown during 1932, 490 were selected, representing 16 per cent. of the total grown. This high percentage of selected seedlings is due more to the poor qualities of the standard canes of this district than to exceptional seedlings. All selections are based on sucrose content, weight of stools, and general habits; the standard used for comparison is the variety D. 1135. The crosses yielding the best canes in the 1932 propagations were P.O.J. 2878 x H.Q. 409, P.O.J. 2875 x H.Q. 409, N.G. 16 x Q. 813, and Pompey x D. 1135.

During the present year 4,000 seedlings will be planted out, and new combinations comprise matings with *S. spontaneum*, *S. sinense*, and *S. officinarum*.

NORTHERN SUGAR EXPERIMENT STATION, SOUTH JOHNSTONE.

Mr. E. J. R. Barke, Chemist in Charge.

METEOROLOGICAL.

The season of growth of the 1932-33 sugar-cane crop was slightly more favourable than that for the preceding year. An abundance of rain was available during the early planting period of March to June, which permitted of excellent germinations. Although the months of September, October, and November received less than their average rainfall, yet there was sufficient moisture in the soil to sustain rapid growth. The precipitation during the period December, 1932, to February, 1933, was normal, and the crop responded to the rains and high temperatures. The season's rainfall, although below that of the preceding year, was more evenly distributed, and the gradual yearly increase of tonnage of cane per acre has been maintained.

The following are the rainfall records taken at this Station since the year 1919 :—

Year.	Rainfall in inches.	Year.	Rainfall in inches.
1919	97·61	1927	138·11
1920	123·92	1928	118·63
1921	202·52	1929	129·53
1922	107·14	1930	145·54
1923	84·78	1931	137·26
1924	146·71	1932	138·76
1925	118·94	1933 (9 months) ..	116·14
1926	77·50		

Abstract of Meteorological Observations made at the Northern Sugar Experiment Station, South Johnstone, from the 1st September, 1932, to 31st August, 1933—Covering Period of Growth of Experiment Canes.

Month.	Rainfall in Inches.	Number of Wet Days.	Average Rainfall, 13 Years, 1920–1932.	Highest Shade Maximum.	Lowest Shade Maximum.	Mean Shade Maximum.	Highest Shade Minimum.	Lowest Shade Minimum.	Mean Shade Minimum.	Lowest Terrestrial Minimum.	Mean Terrestrial Minimum.	Mean Diurnal Range.	Mean Temperature, 9 a.m.	Mean Relative Humidity of the Air, 9 a.m.
September, 1932	1·55	9	3·19	92·0	77·5	83·8	66·8	50·2	58·8	49·0	57·5	25·0	73·8	76·0
October, 1932..	1·03	7	3·50	102·0	84·8	90·8	71·8	57·0	63·8	55·5	62·5	27·0	81·3	67·2
November, 1932	2·06	14	4·30	96·0	86·0	90·7	72·8	56·5	67·2	55·0	65·9	23·5	76·9	88·2
December, 1932	20·92	18	11·31	102·5	84·0	94·2	76·0	65·2	70·4	64·0	69·1	23·8	82·8	72·1
January, 1933	6·25	11	20·23	94·5	90·0	92·2	76·5	68·5	72·2	67·0	70·8	20·0	83·4	75·6
February, 1933	39·58	20	21·30	94·5	75·0	88·1	75·0	63·0	71·9	61·5	70·6	16·2	81·0	84·1
March, 1933 ..	11·76	14	26·56	93·5	85·5	89·7	75·5	63·5	71·4	62·5	68·9	18·3	81·4	82·8
April, 1933 ..	24·57	24	14·43	94·0	78·0	85·1	73·5	62·5	69·3	61·0	68·1	15·8	76·7	86·3
May, 1933 ..	7·78	17	10·33	87·5	77·5	82·4	69·0	56·5	63·4	54·1	61·1	19·0	73·9	83·9
June, 1933 ..	8·08	20	7·00	83·7	70·6	75·8	69·5	46·8	60·2	44·3	58·2	15·6	68·4	82·0
July, 1933 ..	3·60	16	3·79	84·0	72·0	77·8	68·0	48·0	60·7	45·8	58·0	17·1	69·9	82·5
August, 1933 ..	7·35	22	3·30	85·0	70·5	76·0	67·5	47·0	62·1	44·8	59·3	13·9	69·0	85·1
Year ..	134·53	192	129·24	..	..	..	..	..	..	..	..	..	..	*80·5

* Average.

Work of the Northern Sugar Experiment Station—continued.

Experiments Harvested during 1933.

1. *Fertilizer experiment.*—Amounts of nitrogen, phosphoric acid, and potash—Second ratoon crop.
2. *Fertilizer experiment.*—Value of phosphates in different fertilizers and time of application—Second ratoon crop.
3. *Molasses' and fertilizer experiment.*—First ratoon crop.
4. *Varietal and fertility trial.*—First ratoon crop.
5. *Varietal and fertility trial.*—Plant crop.
6. *Optimum growth rate experiment.*—First ratoon crop.

FERTILIZER EXPERIMENT—AMOUNTS OF NITROGEN, PHOSPHORIC ACID, AND POTASH (Second Ratoon Crop).

Plan and Yields.

I.	N 2P 3K 36.1	2N P 3K 40.2	N P 3K 33.9	N 2P K 35.7	2N 2P 3K 45.7	2N P K 39.4
	N 2P 2K 35.2	N P K 32.8	2N 2P K 44.9	2N P 2K 40.6	2N 2P 2K 41.1	N P 2K 33.8
II.	2N 2P 2K 39.8	N 2P K 33.6	N P K 33.4	N P 3K 35.8	2N 2P K 44.6	2N 2P 3K 40.8
	2N P 2K 39.0	2N P 3K 35.5	2N P K 36.7	N 2P 2K 36.6	N 2P 3K 35.7	N P 2K 34.4
III.	2N 2P K 40.2	N P K 31.0	2N 2P 2K 39.6	2N 2P 3K 42.3	2N P 3K 37.3	2N P 2K 38.4
	N P 3K 34.8	N 2P 3K 36.0	N P 2K 32.8	N 2P K 37.5	2N P K 36.3	N 2P 2K 37.2
IV.	N P 3K 33.6	2N P 2K 37.4	2N P K 36.9	2N 2P K 40.4	2N 2P 3K 39.2	2N P 3K 37.7
	N P K 35.5	2N 2P 2K 39.9	N 2P 2K 34.0	N 2P K 37.2	N P 2K 36.0	N 2P 3K 39.6

Block.—B4.

Variety.—Badila.

Harvested.—September, 1933.

Age of Crop.—12 months.

System of Replication.—Four randomised blocks.

Plots.—0·049 acre.

TREATMENT.

Fertilizer.—

N—200 lb. sulphate of ammonia per acre.

2N—400 lb. sulphate of ammonia per acre.

P—300 lb. superphosphate per acre.

2P—600 lb. superphosphate per acre.

K—100 lb. muriate of potash per acre.

2K—200 lb. muriate of potash per acre.

3K—300 lb. muriate of potash per acre.

PREPARATION OF LAND.

Plant Crop.—A good crop of Mauritius Bean was ploughed under in May, and, after decomposition of organic matter, the land was ploughed and harrowed twice. Cane was planted in August, 1930.

Ratoon Crops.—All plots were ratooned by ploughing away from cane and centres broken with a skeleton plough to a depth of 12 inches.

Work of the Northern Sugar Experiment Station—continued.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half Log_e (Mean Square).
Blocks	3	12.18	4.06	..
Nitrogen (N)	1	255.30	255.30	2.7712
Phosphate (P)	1	104.14	104.14	2.3227
Potash (K)	2	3.57	1.79	0.2912
Interactions—				
Nitrogen and Phosphate ..	1	5.01	5.01	0.8057
Nitrogen and Potash	2	6.26	3.13	0.5705
Phosphate and Potash	2	3.14	1.57	0.2255
Nitrogen, Phosphate, and Potash	2	13.35	6.68	0.9496
Errors	33	97.76	2.96	0.5426
Total	47	500.71	..	..

Crop Yields.

Treatment.	Sulphate of Ammonia.		Superphosphate.		Muriate of Potash.		
	200 lb.	400 lb.	300 lb.	600 lb.	100 lb.	200 lb.	300 lb.
Cane—Tons per acre ..	**35.13**	**39.74**	**35.97**	**38.91**	**37.25**	**37.24**	**37.82**
Cane—Percentage of mean yield	93.8	106.2	96.1	103.9	99.5	99.5	101.0
C.C.S. in Cane—Per cent. ..	**15.60**	**15.39**	**15.57**	**15.42**	**15.45**	**15.49**	**15.55**
C.C.S.—Tons per acre ..	**5.48**	**6.11**	**5.60**	**6.00**	**5.75**	**5.77**	**5.88**
Standard Error ..	**0.94** per cent.		**0.94** per cent.		**1.15** per cent.		

Summary of Crop Yields—Plant, First, and Second Ratoon Crops.

Plots receiving—	Plant Crop.			First Ratoon Crop.			Second Ratoon Crop.		
	Cane per acre.	C.C.S	C.C.S. per acre.	Cane per acre.	C.C.S.	C.C.S per acre.	Cane per acre.	C.C.S.	C.C.S. per acre.
	Tons.	Per cent.	Tons.	Tons.	Per cent.	Tons.	Tons.	Per cent.	Tons.
200 lb. sulphate of ammonia	48.29	16.3	7.88	36.40	17.0	6.19	35.13	15.60	5.48
400 lb. sulphate of ammonia	49.15	16.3	8.01	40.13	16.8	6.74	39.74	15.39	6.11
300 lb. superphosphate ..	47.48	16.4	7.77	36.67	16.9	6.20	35.97	15.57	5.60
600 lb. superphosphate ..	49.96	16.3	8.12	39.85	16.9	6.73	38.91	15.42	6.00
100 lb. muriate of potash ..	48.42	16.3	7.87	37.73	16.9	6.38	37.25	15.45	5.75
200 lb. muriate of potash ..	48.83	16.3	7.94	38.38	16.9	6.49	37.24	15.49	5.77
300 lb. muriate of potash ..	48.92	16.4	8.01	38.68	17.0	6.58	37.82	15.55	5.88

Work of the Northern Sugar Experiment Station—continued.

DISCUSSION AND CONCLUSIONS.

This experiment has continued through the plant, first, and second ratoon crops, and is now complete. It has yielded very valuable information with respect to the plant-food requirements of crops grown on the acid alluvial soil of the area. These may be summarised as follows :—

Nitrogen.—Following a good green manure crop, the plant cane showed no appreciable response to added sulphate of ammonia. For the succeeding ratoons, however, deficiencies in this plant-food are evident, and the 400 lb. dressing was very definitely superior to the 200 lb. application. The sulphate of ammonia had a slight depressing influence on the c.c.s., equal to approximately 0·2 unit.

Phosphate.—For all three crops, the 600 lb. application produced an increase in yield of approximately 3 tons of cane per acre over those areas receiving only 300 lb. per acre.

Potash.—The influence of added potash on crop yield has been slight for all crops. In no case was the increase equal to 1 ton of cane per acre, and it may be concluded that 100 lb. per acre was sufficient to enable the soil to supply the full requirements of the crop. A small, though definite, influence of potash on the c.c.s. of the crop was detected, which is in accordance with previous findings. Where potash is entirely eliminated from fertilizer mixtures employed on soils of this type, the influence is even greater, and may amount to 0.5 unit, particularly with crops harvested early in the season. In other words, added potash hastens maturity.

Conclusions.—It may be concluded from this trial that an economic dressing per acre would consist of—

600 lb. superphosphate

100 lb. potash

per acre, mixed and applied in the drill with the cane plants, or as a ratooning mixture. Sulphate of ammonia should then be applied as follows :—

(1) **Plant Cane.**—Following a green manure crop, none required. Following a bare fallow, probably 200 to 300 lb. per acre.

(2) **Ratoon Cane.**—At least 400 lb. per acre, applied in two dressings, at intervals of four weeks. The first dressing should be applied immediately following ratooning.

This manure should always be applied early so as to obviate delayed maturity.

Work of the Northern Sugar Experiment Station—continued.

FERTILIZER TRIAL—VALUE OF PHOSPHATES IN DIFFERENT FERTILIZERS AND TIME OF APPLICATION (Second Ratoon Crop).

Plan and Yields.

N Ps K Early 43.6	N Pm K Early 39.2	N Pb K Early 33.7	N Ps K Late 32.5	N Ps K Early 36.2
N Pm K Early 42.3	N Pb K Early 33.9	N Pb K Late 30.8	N Pb K Late 30.9	N Pb K Late 32.3
N Pb K Late 40.0	N Ps K Late 31.5	N Pm K Early 32.3	N Ps K Early 33.1	N Pm K Early 32.7
N Pm K Late 38.8	N Ps K Early 36.2	N Ps K Late 31.3	N Pb K Early 32.7	B Pb K Early 33.7
N Pb K Early 42.7	N Pb K Late 33.1	N Ps K Early 34.8	N Pm K Early 34.8	N Ps K Late 30.8
N Ps K Late 40.4	N Pm K Late 36.2	N Pm K Late 32.1	N Pm K Late 33.1	N Pm K Late 34.4
Blocks I.	II.	III.	IV.	V.

Block.—A1.

Variety.—Badila.

Harvested.—August, 1933.

Age of Crop.—12 months.

System of Replication.—Five randomised blocks.

Plots.—0·065 acre.

TREATMENT.

(1.) *Fertilizer*—

Ps—400 lb. superphosphate per acre.

Pb—467 lb. basic-superphosphate containing P_2O_5, equivalent of 400 lb. superphosphate per acre.

Pm—177 lb. monammonium phosphate, containing P_2O_5, equivalent of 400 lb. superphosphate per acre.

(2.) *Time of Application*—

Early—In furrow at time of ratooning.

Late—Two months after ratooning.

PREPARATION OF LAND.

Plant Crop.—A heavy crop of Mauritius Bean was ploughed under in March, and, after decomposition of organic matter, the land was ploughed and harrowed twice. Cane was planted in May, 1930.

Ratoon Crops.—The plots were ratooned by ploughing away from cane and centres broken with skeleton plough to a depth of 12 inches.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half Log_e (Mean Square).
Blocks	4	303·05	75·76	..
Quality of phosphate	2	7·34	3·67	0·6501
Time of application	1	37·86	37·86	1·8170
Errors	22	62·56	2·84	0·5219
Total	29	410·81	..	..

Work of the Northern Sugar Experiment Station—continued.

Crop Yields.

	Form of Phosphate.			Time of Application.	
	Superphosphate.	Basic Superphosphate.	Monammonium Phosphate.	Early.	Late.
Cane, tons per acre	**35·04**	**34·38**	**35·59**	**36·13**	**33·88**
Cane, percentage of mean yield	100·1	98·2	101·7	103·2	96·8
C.C.S. in cane, per cent.	**16·0**	**16·0**	**15.9**	**15.9**	**16.0**
C.C.S., tons per acre	**5.61**	**5.50**	**5.66**	**5.74**	**5.42**
Standard Error	**1·52** per cent.			**1·24** per cent.	

Summary of Crop Yields—Plant, First, and Second Ratoons.

Treatment.	Plant Crop.			First Ratoon Crop.			Second Ratoon Crop.		
	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.	Cane per Acre.	C.C.S in Cane.	C.C.S. per Acre.	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.
Phosphate as—	Tons.	Per cent.	Tons.	Tons.	Per cent.	Tons.	Tons.	Per cent.	Tons.
Superphosphate	**46.16**	16·12	**7.44**	**31.78**	16·2	**5.15**	**35.04**	16·0	**5.61**
Basic superphosphate ..	**46.41**	16·13	**7.49**	**31.53**	16·3	**5.14**	**34.39**	16.0	**5.50**
Monammonium phosphate	**46.23**	16·12	**7.45**	**32.46**	16·3	**5.29**	**35.58**	15·9	**5.66**
Fertilizer applied—									
Early	**46.67**	16·19	**7.56**	**32.70**	16·3	**5.33**	**36.13**	15·9	**5.74**
Late	**45.86**	16·05	**7.36**	**31.14**	16·2	**5.04**	**33.88**	16·0	**5.42**

DISCUSSION.

Form of Phosphate.—The results for the second ratoon crop follow those of the previous crops very closely. When applied in equivalent amounts, all three forms are of equal value. Since superphosphate is the most economical manure, its use is recommended.

In the latest yields there is a suggestion that monammonium phosphate is slightly superior to the other forms, but the difference in yields is not significant.

Time of Application.—From the second ratoon yields it is seen that early application of manures becomes increasingly important with successive crops. The yield differences to date are as follows :—

Plant cane .. .. 0·81 tons

First ratoons .. .. 1·56 tons

Second ratoons .. .. 2·25 tons

It is pleasing to note that growers are rapidly appreciating the necessity for early manuring if the best results are to be obtained.

Work of the Northern Sugar Experiment Station—continued.

MOLASSES AND FERTILIZER EXPERIMENT (First Ratoon Crop).

Plan and Yields.

Fertilizer	**Check**	**Molasses**
40.13	**31.50**	**40.20**
Check	**Molasses**	**Fertilizer**
29.70	**39.50**	**43.10**
Molasses	**Fertilizer**	**Check**
43.75	**44.75**	**29.38**

Block.—A3.

Variety.—Badila.

Harvested.—September, 1933.

Age of Crop.—12 months.

System of Replication.—3 x 3 Latin square.

Plots.—One-tenth acre.

TREATMENTS.

Plant Crop.

Molasses.—Ten tons per acre applied broadcast and allowed to decompose before planting.

Fertilizer.—The following fertilizer equivalent in plant-food content to 10 tons of molasses :—

1,010 lb. sulphate of ammonia per acre ;
165 lb. superphosphate per acre ;
860 lb. sulphate of potash per acre.

The superphosphate, sulphate of potash, and one-third of the sulphate of ammonia were applied broadcast before planting. The remainder of the sulphate of ammonia was applied in two equal dressings after the crop had been planted, at intervals of six weeks.

Check.—No treatment.

First Ratoon Crop.

No further applications of molasses or fertilizer were made, and the cane was ratooned in the usual manner.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half Log_e (Mean Square).
Rows	2	7·55	3·78	..
Columns	2	1·66	0·83	..
Treatments	2	277·74	138·87	2·4670
Errors	2	14·75	7·38	0·9994
Total	8	301·70	..	..

Crop Yields.

—	Check.	10 tons Molasses per acre.	Fertilizer equivalent to 10 tons Molasses per acre.
Cane, tons per acre	**30.19**	**41.15**	**42·66**
Cane, percentage of mean yield	79·5	108·3	112·2
C.C.S. in cane, per cent.	**15.6**	**15.3**	**15.3**
C.C.S., tons per acre	**4.71**	**6.30**	**6.53**
Standard Error	**4.13** per cent.		

Work of the Northern Sugar Experiment Station—continued.

Summary of Crop Yields—Plant and First Ratoon Crops.

	Plant Crop.			First Ratoon Crop.		
	Check.	10 Tons Molasses per Acre.	Fertilizer Equivalent to 10 Tons Molasses per Acre.	Check.	10 Tons Molasses per Acre.	Fertilizer Equivalent to 10 tons Molasses per Acre.
Cane, tons per acre	28.43	41.27	38.30	30.19	41.15	42.66
C.C.S. in cane per cent.	16.0	15.3	15.6	15.6	15.3	15.3
C.C.S., tons per acre	4.54	6.32	5.97	4.71	6.30	6.53

DISCUSSION.

An application of 10 tons of molasses per acre prior to planting showed an increase of almost 13 tons of cane per acre on the plant crop; with no further treatment, the first ratoon yield from the molasses plots was 11 tons of cane in advance of the non-treated area. The 10-ton molasses application has, therefore, resulted in an increased yield per acre of 24 tons of cane, over two crops. The experiment will be carried through the second ratoons to determine the full residual effect of the molasses.

It should be pointed out also that the molasses has exhibited a marked mellowing effect on this heavy alluvial soil, and there is no doubt that the utilization of this by-product as a fertilizer provides one of the soundest and most highly economical means of its disposal. It is pleasing to note, also, that farmers are rapidly appreciating its value in this regard.

The yield from the fertilizer plots was slightly in advance of that from the molasses, on the first ratoons, but the difference is not significant.

VARIETAL AND FERTILITY TRIAL (First Ratoon Crop).

Plan and Yields.

Badila 3P Ks 30.8	POJ 2878 N 2P Ks 43.9	POJ 2878 N 3P Km 43.3	POJ 2878 3P Km 37.7	Badila 2P Km 26.5	Badila N 2P Km 32.2
Badila 2P Ks 28.8	POJ 2878 2P Km 35.8	Badila N 2P Km 31.8	POJ 2878 N 3P Ks 42.5	Badila N 3P Km 38.6	POJ 2878 3P Km 38.9
POJ 2878 N 2P Km 42.2	Badila N 3P Ks 31.8	POJ 2878 2P Ks 32.2	Badila N 2P Ks 30.0	POJ 2878 N 2P Ks 37.6	Badila 2P Ks 27.2
Badila N 3P Km 36.8	Badila 3P Km 29.3	POJ 2878 3P Ks 36.6	POJ 2878 2P Km 33.2	Badila 3P Ks 31.1	POJ 2878 N 3P Ks 43.1
Blocks	I.		II.		

Block.—B2.

Varieties.—Badila and P.O.J. 2878.

Harvested.—June, 1933.

Age of Crop.—11 months.

System of Replication.—Two randomised blocks.

Plots.—0·0975 acre.

TREATMENT.

Fertilizer.—

N—200 lb. sulphate of ammonia per acre;

2P—600 lb. superphosphate per acre;

3P—900 lb. superphosphate per acre;

Km—150 lb. muriate of potash per acre.;

Ks—156 lb. sulphate of potash per acre.

PREPARATION OF LAND.

Plant Crop—A good crop of Mauritius Bean was ploughed under in May, and, after decomposition of organic matter, the land was ploughed and harrowed twice. Cane was planted in July, 1931.

Ratoon Crop—The plots were ratooned by ploughing away from cane and centres broken with skeleton plough to a depth of 12 inches.

Work of the Northern Sugar Experiment Station—continued.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half Log_e (Mean Square).
Blocks	1	0·92	0·92	..
Quantity of nitrogen (N)	1	179·85	179·85	2·5951
Quantity of phosphate (P)	1	65·37	65·37	2·0901
Varieties	1	353·43	353·43	2·9338
Muriate v. sulphate of potash	1	4·77	4·77	0·7812
Interactions—				
Quantity of N and P	1	0·22	0·22	..
Quantity of N and varieties	1	4·77	4·77	..
Quantity of P and varieties	1	0·92	0·92	..
Quantity of N and P and varieties	1	3·67	3·67	..
Errors	14	57·66	4·12	0·7079
Total	23	671·58	..	..

Crop Yields.

—	Badila.	P.O.J. 2878.	Superphosphate.		Sulphate of Ammonia.		Potash.	
			600 lb.	900 lb.	None.	200 lb.	Muriate.	Sulphate.
Cane, tons per acre	**31.24**	**38.92**	**33.45**	**36.71**	**32.34**	**37.82**	**35.52**	**34.64**
Cane, percentage of mean yield	89·1	110·9	95·4	104·6	92·2	107·8	101·3	98·7
C.C.S. in cane, per cent.	**14.6**	**13.2**	**14.0**	**13.75**	**14.0**	**13.8**	**13.92**	**13.88**
C.C.S., tons per acre	**4.56**	**5.14**	**4.68**	**5.05**	**4.53**	**5.22**	**4.94**	**4.81**

Standard Error .. .. **1.67** per cent.

Summary of Crop Yields—Plant and First Ratoon Crops.

—	Badila.	P.O.J. 2878.	Superphosphate.		Sulphate Ammonia.		Potash.	
			600 lb.	900 lb.	Nil.	200 lb.	Muriate.	Sulphate.
Plant Crop.								
Cane, tons per acre	**34.18**	**39.88**	**35.15**	**38.90**	**35.99**	**38.07**	**37.62**	**36.44**
C.C.S. in cane, per cent.	**15.85**	**13.99**	**14.95**	**14.88**	**15.00**	**14.83**	**14.90**	**14.93**
C.C.S., tons per acre	**5.44**	**5.60**	**5.26**	**5.79**	**5.40**	**5.65**	**5.61**	**5.44**
First Ratoon Crop.								
Cane, tons per acre	**31.24**	**38.92**	**33.45**	**36.71**	**32.34**	**37.82**	**35.52**	**34.64**
C.C.S. in cane, per cent.	**14.6**	**13.2**	**14.0**	**13.75**	**14.0**	**13.8**	**13.92**	**13.88**
C.C.S., tons per acre	**4.56**	**5.14**	**4.68**	**5.05**	**4.53**	**5.22**	**4.94**	**4.81**

Work of the Northern Sugar Experiment Station—continued.

DISCUSSION AND CONCLUSIONS.

The canes on this experiment lodged badly late in the growing season, and as the maturity tests indicated that the juice quality was deteriorating, the plots were harvested at 11 months. The trial is now concluded, and the results may be summarised as follows :—

P.O.J. 2878 *v. Badila.*—On the plant crop, the Javan variety outyielded the standard (Badila) by 5·7 tons, and on the first ratoons it showed an increase of 7·7 tons per acre. In each case, however, the c.c.s. of Badila was markedly superior, and under these conditions, it is the preferable variety.

It should be stressed that P.O.J. 2878 cannot be considered as a serious rival to Badila on the better northern lands ; its increased growth vigour suggests that it may be a valuable cane on the poorer lands with less favourable rainfall. Even under these conditions, its susceptibility to Red Stripe (Toprot) disease is a serious drawback, and its late-maturing characteristics may also be an objectionable feature. The secret of success with this variety appears to lie in early planting. This eliminates to a great extent the tendency for the production of " suckers " late in the season.

Superphosphate.—The results for the ratoon crop confirm those for the previous year, and they show clearly that an application of 900 lb. of superphosphate per acre is highly economical on the acid alluvial soil of the area.

Sulphate of Ammonia.—Although the plant crop showed but slight response to added nitrogen, the ratoon yield was markedly increased by an application of 200 lb. of sulphate of ammonia per acre. The increase (5·5 tons of cane) suggests that a much heavier application would have been profitable.

Muriate v. Sulphate of Potash.—The results for the ratoon crop confirm those of the previous year. The apparent superiority of the muriate form is not significant, and it must be concluded that equivalent amounts of the two forms are of equal value for cane.

Differential Response between Varieties and Fertilizers.—With the plant crop it was suggested that Badila exhibits a greater response to heavier dressings of fertilizer than does P.O.J. 2878. This was not confirmed by the ratoon yields.

VARIETAL AND FERTILITY TRIAL (Plant Crop).

Plan and Yields.

I.

POJ 2878	NG 15	POJ 2878	NG 15
NP	2N 2P	2N P	N 2P
34.2	35.6	37.5	34.0
NG 15	POJ 2878	NG 15	POJ 2878
2N P	N 2P	NP	2N 2P
35.8	35.1	30.2	41.2

II.

POJ 2878	NG 15	POJ 2878	NG 15
N 2P	2N P	2N 2P	NP
34.6	33.2	38.7	31.8
NG 15	POJ 2878	NG 15	POJ 2878
2N 2P	NP	N 2P	2N P
35.5	34.0	32.7	39.2

Block.—B1.

Varieties.—Badila (N.G. 15) and P.O.J. 2878.

Harvested.—October, 1933.

Age of Crop.—13 months.

System of Replication.—Two randomised blocks.

Plots.—0·146 acre.

TREATMENT.

Fertilizer.—All plots received 150 lb. muriate of potash per acre.

N—300 lb. sulphate of ammonia per acre.

2N—600 lb. sulphate of ammonia per acre.

P—300 lb. superphosphate per acre.

2P—600 lb. superphosphate per acre.

PREPARATION OF LAND.

The previous stools were ploughed out in July, 1932. Land ploughed and harrowed three times. Planted August, 1932.

Work of the Northern Sugar Experiment Station—continued.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half Log_e (Mean Square).
Blocks	1	0·95	0·95	..
Varieties	1	41·28	41·28	1·8602
Nitrogen (N)	1	56·63	56·63	2·0183
Phosphate (P)	1	8·27	8·27	1·0563
Errors	11	14·07	1·28	0·1234
Total	15	121·20	..	..

Crop Yields.

	Badila.	P.O.J. 2827	Sulphate of Ammonia.		Superphosphate.	
			300 lb.	600 lb.	300 lb.	600 lb.
Cane, tons per acre	**33.60**	**36.81**	**33.33**	**37.09**	**34.49**	**35.93**
Cane, percentage of mean yield	95·4	104·6	94·6	105·4	98·0	102·0
C.C.S. in cane, per cent.	**15.32**	**13.22**	**14.50**	**14.03**	**14.27**	**14.26**
C.C.S., tons per acre	**5.15**	**4.87**	**4.83**	**5.20**	**4.92**	**5.12**

Standard Error .. .. **1.14** per cent.

DISCUSSION.

In view of the unfavourable conditions which accompanied the plant cane in the previous trial with these two varieties, the experiment was repeated. Once again P.O.J. 2878 outyielded Badila as regards cane per acre—this time by 3·2 tons. Again, also, the c.c.s. of the Javan cane was 2·1 units. below that of Badila. As was pointed out (p. 32), satisfactory returns with P.O.J. 2878 can be expected only where it is planted early. Late suckering was particularly pronounced in the plots of this trial.

The crop responses to nitrogen and phosphate on this experiment are very interesting, as they confirm those previously recorded (*see* Annual Report, 1930, p. 19) with a "plough out and replant." The double dressing of sulphate of ammonia was responsible for an increase of 3·76 tons of cane, while the heavier application of superphosphate resulted in an additional 1·44 ton of cane over that from the single dressing. Following the fallow, phosphates are always productive of pronounced increases on this soil type; apparently nitrogen deficiency is the important limiting factor with cane following cane.

The heavier application of nitrogen has also adversely influenced the c.c.s. of the crop.

Work of the Northern Sugar Experiment Station—continued.

OPTIMUM GROWTH RATE EXPERIMENT—FIRST RATOONS.

Block.—E.

Variety.—Badila.

Age of Crop.—12 months.

Harvested.—22nd August, 1933.

TREATMENT.

Fertilizer.—The following monthly dressings were applied to both plots :—

20 lb. muriate of potash per acre ;

50 lb. superphosphate per acre ;

100 lb. sulphate of ammonia per acre.

Irrigation.—

Winter—Two inches per acre per week in two applications.

Spring—Four inches per acre per week in two applications.

Summer—Six inches per acre per week in three applications.

Method of Ratooning.—The stools were cut to a width of 9 inches, and the ground worked to a depth of 24 inches.

Crop Yields.

—	Cane per acre.	C.C.S. in Cane.	C.C.S. per acre.
	Tons.	Per cent.	Tons.
Early Plant	**75.30**	15·7	**11.82**
Late Plant	**71.72**	15·8	**11.33**

Summary of Crop Yields.

—	Plant Crop.			First Ratoon Crop.		
	Cane per acre.	C.C.S. in Cane.	C.C.S. per acre.	Cane per acre.	C.C.S. in Cane.	C.C.S. per acre.
	Tons.	Per cent.	Tons.	Tons.	Per cent.	Tons.
Early Plant	**143.9**	15·9	**22.88**	**75.30**	15·7	**11.82**
Late Plant	**58.3**	15·8	**9.21**	**71.72**	15·8	**11.33**

DISCUSSION.

Following the removal of the plant cane, both plots were thoroughly cultivated to 24 inches, and favourable conditions of moisture and plant-food supply maintained, as far as possible, throughout the growth of the ratoons.

Heavy yields were again experienced ; though there was a considerable reduction in crop following the autumn plant, that following the spring plant showed a decided increase. Both ratoon crops yielded at the rate of almost 1 ton of sugar per acre per month.

Work of the Northern Sugar Experiment Station—continued.

DETAILS OF ANALYTICAL WORK PERFORMED AT THE LABORATORY OF THE SUGAR EXPERIMENT STATION AT SOUTH JOHNSTONE, FROM 1st NOVEMBER, 1932, TO 31st OCTOBER, 1933.

Materials.	Number of Analyses.
Sugar-cane for growers	164
Sugar-cane for Experiment Station	464
Sugar-cane for Experiment Station (Refractometer)	18,652
Sugar-cane fibres	68
Coral lime	6
Agricultural lime	8
Burnt lime	4
Fertilizers	26
Waters	4
Soils	208
Total	19,604

YIELD OF CANE HARVESTED FROM THE SUGAR EXPERIMENT STATION AT SOUTH JOHNSTONE—SEASON 1933.

	Tons.
Cane sent to mill	521·3
Used for plants, seedling propagation, analysis, and show exhibits	27·2
Total	548·5

Nature of Crop—	Per cent.
Plant cane	30·1
First ratoon	30·0
Second ratoon	32·9
Third ratoons	7·0

Tonnages—	Tons.
Badila plant	49·05
Badila first ratoons	70·75
Badila second ratoon	156·2
Badila third ratoon	34·2
Varieties	238·3
Acreage under cane	14·3
Tons per acre	38·36

CENTRAL SUGAR EXPERIMENT STATION, MACKAY.

Mr. F. Keogh, Chemist in Charge.

METEOROLOGICAL.

The rainfall during the 1932 planting season was more favourable than that of the previous year, the falls in May and June supplying sufficient moisture to ensure good germinations. Following planting, rain was scanty until the end of November. From this month to the end of February, growing conditions were satisfactory in most parts of the district. March was very dry, the cane receiving a severe check in growth. Those parts of the district which received insufficient rain during the previous month suffered severely; the cane wilted badly and became "trash-bound." Good rains followed from the beginning of April until the end of September, and the cane made good winter growth.

This season was similar to the past two years up to the end of March, but whereas in 1931 and 1932 the winter and spring rainfalls were below the average, this year the falls were considerably above. The generous falls of rain from April onwards have kept the cane growing constantly, and the crop is being received at the mills in good condition for milling. In previous years much wilted and partly dead cane was harvested.

The following table shows the monthly rainfall distribution for the past four years :—

Month.	1929-30.	1930-31.	1931-32.	1932-33.
September	·02	·28	·31	·76
October	·56	·62	·94	·28
November	·90	1·21	5·67	2·02
December	2·73	2·71	6·17	8·03
January	28·94	4·12	25·51	7·27
February	4·38	5·32	2·00	20·92
March	4·39	5·31	·76	·96
April	1·14	1·27	2·75	4·40
May	7·88	1·66	4·52	1·72
June	3·38	·26	1·15	3·53
July	·28	·19	·37	9·64
August	·60	·04	·35	1·66
Total	55·20	22·99	50·50	61·19

Annual Rainfall since 1920 at the Sugar Experiment Station, Mackay.

Year.	Rainfall in Inches.	Year.	Rainfall in Inches.
1920	57·27	1927	83·87
1921	95·89	1928	78·28
1922	34·47	1929	64·03
1923	25·23	1930	55·81
1924	53·37	1931	30·01
1925	54·80	1932	48·48
1926	34·69	1933 (9 months)	53·11

Abstract of Meteorological Observations made at Sugar Experiment Station, Mackay, from 1st September, 1932, to 31st August, 1933.

Month.	Rainfall in Inches.	Number of Wet Days.	Average Rainfall, 32 Years, 1901–1932.	Highest Shade Maximum.	Lowest Shade Maximum.	Mean Shade Maximum.	Highest Shade Minimum.	Lowest Shade Minimum.	Mean Shade Minimum.	Lowest Terrestrial Min.	Mean Terrestrial Min.	Mean Diurnal Range.	Mean Temperature, 9 a.m.	Mean Relative Humidity of the Air, at 9 a.m. Saturation equalling 100.
September, 1932	·76	3	1·76	94·0	73·0	81·1	67·0	48·6	55·4	46·8	53·3	25·7	74·2	65·0
October, 1932..	·28	2	1·67	99·2	79·0	87·6	76·5	55·0	64·3	53·0	62·5	23·3	80·2	60·0
November, 1932	2·02	8	2·93	95·8	80·5	86·7	74·0	60·0	67·0	59·0	65·8	19·7	81·8	58·0
December, 1932	8·03	12	7·94	96·5	80·5	86·7	77·0	64·5	70·6	64·0	69·8	16·1	81·9	69·0
January, 1933	7·27	9	15·72	94·0	81·8	89·0	76·9	64·0	70·9	63·8	70·6	18·1	83·6	71·5
February, 1933	20·92	15	9·69	96·0	75·8	83·8	76·0	65·0	71·2	63·0	70·5	12·6	83·3	70·0
March, 1933 ..	·96	7	9·84	96·2	83·8	87·5	77·5	62·5	69·5	62·0	68·6	18·0	82·1	74·8
April, 1933 ..	4·40	13	5·64	91·2	74·0	82·5	75·2	58·2	67·4	56·8	66·4	15·1	77·1	75·6
May, 1933 ..	1·72	6	3·26	87·0	73·0	79·7	69·0	50·0	60·0	47·0	58·2	19·7	71·6	75·0
June, 1933 ..	3·53	7	2·58	78·0	65·0	72·3	62·2	40·0	51·9	36·8	48·7	20·4	64·4	78·0
July, 1933 ..	9·64	16	1·56	81·0	61·2	71·1	70·0	40·8	54·6	35·8	52·2	16·5	64·7	78·0
August, 1933 ..	1·66	7	1·01	81·7	66·0	72·6	64·0	38·0	53·4	35·5	50·5	19·2	66·4	75·5
Year ..	61·19	105	..	..	..	..	..	..	..	..	..	..	..	*70·9

*Average.

Experiments Harvested during 1933.

1. *Fertilizer Trial.*—Forms of nitrogen, phosphate, and potash—First ratoon crop.

2. *Molasses Trial.*

3. *Fertilizer Trial.*—Amounts and forms of nitrogen and phosphate; lime; time of application—First ratoon crop.

4. *Fertilizer Trial.*—Amounts of nitrogen—First ratoon crop.

Work of the Central Sugar Experiment Station—continued.

FERTILIZER TRIAL—FORMS OF NITROGEN, PHOSPHATE, AND POTASH
(First Ratoon Crop).

Plan and Yields.

I.	Nn Ps Km	17.6	Nn Pb Km	21.4	III.
	Na Pb Ks	17.5	Nn Ps Ks	24.8	
	Nn Pr Ks	17.0	Na Pr Km	26.2	
	Na Pbs Km	16.0	Na Pbs Ks	22.8	
	Nn Pb Km	16.7	Na Pb Ks	22.1	
	Nn Ps Ks	19.6	Nn Ps Km	22.6	
	Na Pbs Ks	23.1	Nn Pr Ks	25.0	
	Na Pr Km	23.1	Na Pbs Km	21.2	
	Na Ps Km	25.3	Nn Pr Km	20.6	
	Na Pr Ks	25.5	Na Ps Ks	22.3	
	Nn Pb Ks	30.7	Na Pb Km	25.1	
	Nn Pbs Km	32.1	Nn Pbs Ks	30.8	
II.	Na Ps Ks	31.0	Na Pr Ks	21.9	IV. *
	Nn Pr Km	34.2	Na Ps Km	22.8	*
	Nn Pbs Ks	37.9	Nn Pbs Km	28.4	
	Na Pb Km	35.7	Nn Pb Ks	27.1	

* Damaged by erosion.

Block.—B1.

Variety.—Q. 813.

Harvested.—September, 1933.

Age of Crop.—12 months.

System of Replication.—Four randomised blocks.

Plots.—·0607 acre.

TREATMENTS.

Na—200 lb. sulphate of ammonia.

Nn—260 lb. nitrate of soda.

Pb—260 lb. bonemeal.

Ps—300 lb. superphosphate + 75 lb. dried blood.

Pbs—388 lb. basic superphosphate + 75 lb. dried blood.

Pr—290 lb. rock phosphate + 75 lb. dried blood.

Km—150 lb. muriate of potash.

Ks—156 lb. sulphate of potash.

GROWTH NOTES.

This trial was ratooned 12 inches deep with the subsoiler, and mixed fertilizer applied immediately. The top-dressing of nitrogenous fertilizer was applied on 10th January. The cane made moderate growth throughout. Stools that were backward in the plant crop owing to pest damage were also weak in the ratoon crop. Two plots were affected by soil erosion during the heavy rains in February.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half Log_e (Mean Square).
Blocks	3	613·34	204·45	..
Forms of nitrogen	1	19·38	19·38	1·4822
Forms of phosphate	3	45·98	15·33	1·3649
Forms of potash	1	3·19	3·19	0·5800
Errors	23	298·35	12·97	1·2814
Total	31	980·24	..	..

Work of the Central Sugar Experiment Station—continued.

Crop Yields.

—	Forms of Nitrogen.		Forms of Phosphate.				Forms of Potash.	
	Sulphate of Ammonia.	Nitrate of Soda.	Bone.	Super.	Basic Super.	Rock Phosphate.	Muriate.	Sulphate.
Cane, tons per acre	**23.85**	**25.41**	**24.54**	**23.25**	**26.54**	**24.19**	**23.31**	**24.94**
Cane, percentage of mean yield	96·8	103·2	99·6	94·4	107·8	98·2	98·7	101·3
C.C.S. in cane, per cent.	**16.10**	**15.97**	**15.92**	**16.24**	**15.76**	**16.24**	**16.06**	**16.01**
C.C.S., tons per acre	**3.84**	**4.06**	**3.91**	**3.78**	**4.18**	**3.93**	**3.90**	**3.99**
Standard Error	**3.65** per cent.		**5.17** per cent.				**3.65** per cent.	

Summary of Crop Yields—Plant and First Ratoon Crops.

Plots Receiving—	Plant Crop.			First Ratoon Crop.		
	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.	Cane per Acre.	C.C.S. in Cane.	C.C.S per Acre.
		Per cent.			Per cent.	
Sulphate of ammonia	**19.24**	16·8	**3.23**	**23.85**	16·10	**3.84**
Nitrate of soda	**19.45**	16·8	**3.27**	**25.41**	15·97	**4.06**
Bonemeal	**19.35**	16·8	**3.25**	**24.54**	15·92	**3.91**
Superphosphate	**19.25**	16·5	**3.18**	**23.25**	16·24	**3.78**
Basic superphosphate	**21.11**	16·9	**3.57**	**26.54**	15·76	**4.18**
Rock phosphate	**17.66**	16·9	**2.98**	**24.19**	16·24	**3.93**
Muriate of potash	**19.27**	16·8	**3.24**	**24.31**	16·06	**3.90**
Sulphate of potash	**19.42**	16·8	**3.26**	**24.94**	16·01	**3.99**

DISCUSSION.

The purpose of this experiment was to determine the relative values of different forms of nitrogenous, phosphatic, and potash fertilizers. As was pointed out last year, the stand of cane was irregular, due to Pentodon beetle attack in the young plant cane; this seriously affected the precision of the experiment, and it was not possible to draw any conclusions from the results of the plant crop.

The ratoon yields follow those of last year very closely. Though slight differences in yield were recorded, none is significant, and on the basis of these results it must be concluded that the several forms of the plant-foods under review were equally efficient.

Work of the Central Sugar Experiment Station—continued.

MOLASSES TRIAL (First Ratoon Crop).

Plan and Yields.

Fertilizer 12.6	Molasses 15.0	Check 10.8
Check 9.1	Fertilizer 19.3	Molasses 15.8
Molasses 14.8	Check 14.2	Fertilizer 28.4

Block.—C2.

Variety.—Q. 813.

Harvested.—October, 1933.

Age of Crop.—13 months.

System of Replication.—3 x 3 Latin square.

Plots.—0·101 acre.

TREATMENT.

Plant Crop.—

Check.—No fertilizer or molasses.

Molasses.—Ten tons molasses applied broadcast before planting.

Fertilizer.—Plant-food equivalent to that contained in 10 tons molasses was applied broadcast in the following fertilizer :—

900 lb. sulphate of ammonia per acre ; 280 lb. superphosphate per acre ; 1,180 lb. sulphate of potash per acre.

Ratoons.—

No further fertilizer or molasses was applied to the ratoons.

Crop Yields—First Ratoon Crop.

	Check.	Molasses.	Fertilizer.
Cane, tons per acre	11.37	15.20	20.10
Cane, percentage mean yield	73·0	97·7	129·2
C.C.S. in cane, per cent.	16.34	16.71	16.00
C.C.S., tons per acre	1.86	2.54	3.22

Summary of Crop Yields—Plant and First Ratoon Crops.

Treatment.	Plant Crop.			First Ratoon Crop.		
	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.
	Tons.	Per cent.	Tons.	Tons.	Per cent.	Tons.
Check	17.70	18·16	3.21	11.37	16·34	1.86
Molasses	23.70	17·76	4.20	15.20	16·71	2.54
Fertilizer	25.60	17·60	4.50	20.10	16·00	3.22

DISCUSSION.

The influence of the molasses applied to the land two years ago was felt in the ratoon crop just harvested, though not so strongly as with the plant cane. For the two crops, the increased yield has amounted to 10 tons of cane per acre. There can be no doubting the value of this by-product applied as a fertilizer, and in more favourable seasons the crop increases following its use would probably be much greater.

With both plant and ratoon crops the equivalent fertilizer treatment appears to have produced superior crop response ; this is, no doubt, exaggerated by one "Fertilizer" plot of highly fertile soil—an effect which also influenced the plant cane yield.

Work of the Central Sugar Experiment Station—continued.

FERTILIZER TRIAL—LIME, NITROGEN, AND PHOSPHATE TIME OF APPLICATION (First Ratoon Crop).

Plan and Yields.

	LIME.		NO LIME.		LIME.		NO LIME.	
	C	12.1	2Nn 2P Early	24.2	2Nn 2P Early	20.7	1Na 1P Early	23.0
	1Na 1P Early	17.9	1Nn 2P Early	22.2	C	17.5	2Nn 1P Late	27.1
I.	2Nn 1P Late	21.7	2Na 1P Early	26.2	1Nn 2P Early	24.0	1Na 2P Late	28.5
	2Na 2P Late	23.6	C	18.2	1Nn 1P Late	24.7	2Na 2P Late	29.3
	1Na 2P Late	19.7	1Nn 1P Late	22.8	2Na 1P Early	25.9	C	13.6
	1Na 1P Early	21.8	C	14.6	1Nn 1P Late	20.4	1Na 1P Early	21.7
	1Na 2P Late	25.7	2Nn 2P Early	24.8	2Nn 2P Early	24.9	1Nn 2P Early	21.0
III.	1Nn 2P Early	20.3	1Nn 1P Late	19.2	2Nn 1P Late	25.3	2Na 2P Late	23.2
	2Na 2P Late	19.7	2Na 1P Early	20.7	C	14.0	1Na 2P Late	16.0
	C	12.7	2Nn 1P Late	18.6	2Na 1P Early	19.2	C	13.4
	NO LIME.		LIME.		NO LIME.		LIME.	

II. IV.

Block —C1.

Variety.—Q. 813.

Harvested.—October, 1933.

Age of Crop.—13 months.

System of Replication.—Four randomised blocks.

Plots.—·06 acre.

TREATMENTS.

Lime *v.* No Lime.—Four blocks of five plots received 1 ton burnt lime per acre before planting. Remaining twenty plots received no lime.

All plots received 150 lb. muriate of potash per acre.

In addition—

C—no further manure.

1Na—200 lb. sulphate of ammonia per acre.

1Nn—260 lb. nitrate of soda per acre.

2Na—400 lb. sulphate of ammonia per acre.

2Nn—520 lb. nitrate of soda per acre.

1P—200 lb. superphosphate per acre.

2P—400 lb. superphosphate per acre.

Early v. Late applications of fertilizer :—

Early :—At ratooning 12th October, all P and K and one-quarter N. Additional N was applied on 9th January, and for 2N the remainder on 26th January.

Late :—All P and K and one-quarter N on 9th January. Additional N was applied on 26th January, and for 2N the remainder on 20th February.

Crop Yields—First Ratoons.

——	Lime.	No Lime.	No Fertilizer.	Amount of Nitrogen.		Kind of Nitrogen.		Amount of Superphosphate.		Time of Application.	
				1 N	2 N	Sulphate Ammonia.	Nitrate of Soda.	1 P	2 P	Early.	Late.
Cane, tons per acre	20.0	21.9	14.5	21.8	23.4	22.6	22.6	22.3	23.0	22.4	22.8
C.C.S. in cane, per cent. ..	15.72	15.87	15.63	15.89	15.84	15.80	16.0	16.07	15.73	15.86	15.87
C.C.S., tons per acre	3.14	3.47	2.26	3.46	3.70	3.57	3.61	3.58	3.61	3.55	3.61

Work of the Central Sugar Experiment Station—continued.

Summary of Crop Yields—Plant and First Ratoons.

Treatment.	First Ratoons.			Plant Crop.		
	Cane per Acre.	C.C.S.	C.C.S. per Acre.	Cane per Acre.	C.C.S.	C.C.S. per Acre.
	Tons.	Per cent.	Tons.	Tons.	Per cent.	Tons.
Lime	14.87	17·38	2.58	20.0	15·72	3.14
No lime	16.47	17·31	2.85	21.9	15·87	3.47
No fertilizer	13.55	17·46	2.37	14.5	15·63	2.26
1N	16.36	17·47	2.86	21.8	15·89	3.46
2N	16.04	17·17	2.75	23.4	15·84	3.70
Sulphate of ammonia	17.18	17·34	2.98	22.6	15·80	3.57
Nitrate of soda	15.23	17·30	2.63	22.6	16·00	3.61
1P	17.10	17·46	2.99	22.3	16·07	3.58
2P	15.32	17·18	2.63	23.0	15·73	3.61
Early application	15.12	17·28	2.61	22.4	15·86	3.55
Late application	17.30	17·36	3.00	22.8	15·87	3.61

DISCUSSION.

It was hoped that this experiment would yield valuable information on a variety of topics, but pest damage in the plant cane seriously prejudiced the results of both crops.

The only conclusion which may be drawn with certainty is that the applied fertilizer has had a profound influence on the crop yield; the manured cane averaged approximately 8 tons per acre more than the unfertilized. The double dressing of nitrogenous fertilizer (400 lb. of sulphate of ammonia per acre) also appears to have been definitely superior to the single application (200 lb.). Nitrate of soda and sulphate of ammonia were equally effective in this respect.

Work of the Central Sugar Experiment Station—continued.

FERTILIZER TRIAL—AMOUNTS OF NITROGEN (First Ratoon Crop).

Plan and Yields.

4N 20.05	C 11.43	3N 26.12	1N 18.25	2N 19.37
1N 14.95	2N 25.43	4N 29.38	3N 26.25	C 23.37
2N 18.80	3N 26.67	1N 24.69	C 20.87	4N 28.12
C 17.54	1N 27.76	2N 32.00	4N 32.37	3N 32.76
3N 31.96	4N 37.57	C 31.84	2N 34.69	1N 31.87

Block.—B2.
Variety.—Q. 813.
Harvested.—31st August, 1933.
Age of Crop.—10 months.
System of Replication.—5 x 5 Latin square.
Plots.—0·05 acre.

TREATMENT.

Fertilizer.—All plots received—
400 lb. superphosphate per acre;
150 lb. sulphate of potash per acre.

In addition—

C—No further fertilizer.
1N—125 lb. sulphate of ammonia per acre.
2N—250 lb. sulphate of ammonia per acre.
3N—375 lb. sulphate of ammonia per acre.
4N—500 lb. sulphate of ammonia per acre.

GROWTH NOTES.

This crop was ratooned with the subsoiler to 12 inches deep on 7th November, 1932, and mixed fertilizer applied immediately. Rain fell towards the end of November, and the cane made rapid growth during the season.

The first application of nitrogenous fertilizer was made on 20th December, 1932, and plots receiving 3N and 4N received the second dressing on the 27th January, 1933.

Some weak stools were apparent in the ratoons, following serious pest damage to the young cane in the plant crop; also, a few misses that were supplied in the plant crop showed only moderate growth in the ratoons.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half Log_e (Mean Square).
Rows	4	605·28	151·32	..
Columns	4	188·03	47·01	..
Treatments	4	253·33	63·33	2·0742
Errors	12	39·74	3·31	0·5984
Total	24	1,086·38	..	..

Crop Yields.

—	*All plots* receive {400 lb. superphosphate, 150 lb. sulphate of potash} In addition—				
	No Nitrogen.	**1N.** 125 lb. Sulphate of Ammonia.	**2N.** 250 lb. Sulphate of Ammonia.	**3N.** 375 lb. Sulphate of Ammonia.	**4N.** 500 lb. Sulphate of Ammonia.
Cane, tons per acre	**21.01**	**23.50**	**26.06**	**28.75**	**29.50**
Cane, percentage of mean yield	81·6	91·2	101·2	111·6	114·5
C.C.S. in cane, per cent.	**15.37**	**15.21**	**15.07**	**14.63**	**14.37**
C.C.S., tons per acre	**3.23**	**3.57**	**3.93**	**4.20**	**4.24**

Standard Error .. .. **3.16** per cent.

Work of the Central Sugar Experiment Station—continued.

Summary of Crop Yields—Plant and First Ratoons.

Plots Receiving (in addition to Superphosphate and Potash)—	Plant Crop.			First Ratoon Crop.		
	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.	Cane per Acre.	C.C.S. in Cane.	C.C.S. per Acre.
	Tons.	Per cent.	Tons.	Tons.	Per cent.	Tons.
No sulphate ammonia	**15.46**	17·81	**2.76**	**21.01**	15·37	**3.23**
1N—125 lb. sulphate ammonia	**15.24**	17·73	**2.71**	**23.50**	15·21	**3.57**
2N—250 lb. sulphate ammonia	**14.92**	17·86	**2.66**	**26.06**	15·07	**3.93**
3N—375 lb. sulphate ammonia	**16.18**	17·48	**2.83**	**28.75**	14·63	**4.20**
4N—500 lb. sulphate ammonia	**17.10**	17·79	**3.04**	**29.50**	14·37	**4.24**

DISCUSSION.

Although the benefits of added nitrogen were scarcely appreciable on the plant crop, the ratoon yields have been profoundly influenced by sulphate of ammonia. Progressive increases in cane yield were recorded up to the full application of 500 lb. of this manure. This bears out the results reported previously for ratoon crops produced on the deeper alluvial soils of the Mackay area. The increased crop yield recorded in this trial was 8·5 tons of cane per acre where the full dressing was applied.

It will be observed that there is a progressive diminution in the c.c.s. from the canes receiving the heavier dressings of nitrogen. This is probably attributable to delayed maturity rather than to a permanent reduction in sugar content. The cane was only ten months old when harvested.

DETAILS OF ANALYTICAL WORK PERFORMED AT THE SUGAR EXPERIMENT STATION, MACKAY, FROM 1st NOVEMBER, 1932, TO 31st OCTOBER, 1933.

Materials.	Number of Analyses.
Sugar-canes for growers	112
Sugar-canes for Station	80
Sugar-canes for Mackay Show	54
Limestones	6
Waters	10
Maturity test on cane (including reducing sugars)	723
Fibre determinations	3
Milk analyses, Mackay Show	16
Total	1,004

TOTAL TONNAGE OF CANE HARVESTED FROM THE CENTRAL SUGAR EXPERIMENT STATION, MACKAY, SEASON 1933.

	Tons.
Cane sent to mill	305·8
Sold for plants	16·3
Used for plants	2·0
Total	324·1

	Per cent.
Nature of Crop—	
Plant cane	42·4
First ratoon cane	57·6
	Acres.
Acreage harvested	15·49
Average tons per acre—	Tons.
Plant cane	23·9
First ratoon cane	19·1

SOUTHERN SUGAR EXPERIMENT STATION, BUNDABERG.

Mr. J. Pringle, Chemist in Charge.

METEOROLOGICAL.

From a growing standpoint the past season was far from favourable; following on a cold, dry winter in 1932 the period from August to mid-October was for the most part dry, only 27 points being recorded for August, and 150 for September. The crops made little progress till after a fall of 5·35 inches in October. This produced a satisfactory germination in the spring plantings and gave the young ratoons a good start, but as the next few weeks were hot and dry, the growth was checked until further good rains during the latter half of December. Growth was maintained during the following two months, but a further setback was experienced by abnormally hot, dry conditions in March. After a fall of about 7 inches early in April the cane made rapid recovery, and good progress was maintained until retarded by cool conditions in May.

The past winter was mild, only a few light frosts being recorded, causing no damage to the cane; though cool atmospheric conditions delayed the germination in the spring plantings, indications are that there will be a fairly good strike, while the ratoons are coming away well.

Rainfall at the Southern Sugar Experiment Station, Bundaberg, during the Growing Season 1932–33.

Month.	Rainfall. Inches.	Number of Wet Days.
August, 1932	0·27	3
September, 1932	1·50	9
October, 1932	6·79	9
November, 1932	0·27	4
December, 1932	3·07	9
January, 1933	8·93	10
February, 1933	4·11	3
March, 1933	0·68	3
April, 1933	7·84	9
May, 1933	0·83	4
June, 1933	2·18	5
July, 1933	4·60	7
August, 1933	1·39	3
September, 1933	0·97	7
Total	43·43	85

Experiments Harvested during 1933.

(1) Subsoiling combined with machine and hand planting.

(2) Subsoiling combined with Fertilizing.

(3) Fertilizer Trial—Different forms of Phosphates, and amounts of Potash.

(4) Two Trials with Molasses (Plant cane)—

(i.) Three plots using 3, 5, and 7 tons molasses per acre;

(ii.) Three plots using 4, 6, and 8 tons molasses per acre.

(5) Varietal Trial—Co. 281, Co. 290, Manoa 304, P.O.J. 2725, P.O.J. 234, and 26 C. 188, with Q. 813 as standard.

(6) Legume Trial.

New Experiments Initiated.

(1) Irrigation Trial with P.O.J. 2878.

(2) Planting and Cultivation Trial, combining wide and narrow interspacing, deep and shallow planting, and the usual subsequent cultivation *versus* no subsequent cultivation.

(3) Three Trash Conservation Trials—

(i.) Trash ploughed under;

(ii.) Trash placed in alternate rows;

(iii.) Trash Trial combining Relieving, Volunteering, and Rolling.

(4) Planting Trial.

(5) Varietal Trial with P.O.J. 2722, 26 C. 148, P.O.J. 2727, U.D. 1, P.O.J. 213, P.O.J. 2940, 26 C. 99, U.H. 1, U.D. 39, 26 C. 270, P.O.J. 2747, with Q. 813 as standard.

Work of the Southern Sugar Experiment Station—continued.

SUBSOIL TRIAL COMBINED WITH MACHINE AND HAND PLANTING (First Ratoon Crop).

Plan and Crop Yields.

Block I.	II.	III.	
← Non-Subsoiled in Drill. →			Subsoiled.
HP 11.00	MP 10.15	MP 10.03	
← Subsoiled in Drill. →			
HP 10.31	MP 8.47	MP 10.33	
← Subsoiled in Drill. →			Non-subsoiled.
MP 11.30	HP 8.19	HP 10.45	
← Non-Subsoiled in Drill →			
MP 10.15	HP 9.60	HP 12.15	
← Subsoiled in Drill. →			Subsoiled.
HP 13.56	HP 12.42	MP 14.27	
← Non-Subsoiled in Drill. →			
HP 13.00	HP 12.57	MP 13.28	
← Non-Subsoiled in Drill. →			Non-subsoiled.
MP 13.94	MP 12.42	HP 16.81	
← Subsoiled in Drill. →			
MP 11.86	MP 13.13	HP 12.01	
IV.	V.	VI.	

Block.—B6.
Variety.—Q. 813.
Harvested.—October, 1933.
Age of Crop.—12 months.
System of Replication.—Six randomised blocks.
Plots.—0·089 acre.

TREATMENTS.

H P—Hand-planted.
M P—Machine-planted.

Cultivation.—Owing to the effects of continuous dry weather during its growing period coupled with severe frost damage, there was not sufficient cane in the plant crop to warrant harvesting, and all material was cut down in September, 1932, and placed in alternate rows; the clear interspaces were then ratooned with the subsoiler three times per row, the soil being dry at the time. Fertilizer was applied to the plant crop at the rate of 200 lb. muriate of potash and 75 lb. superphosphate per acre in the drills at planting, and top-dressed six weeks later with 160 lb. sulphate of ammonia per acre, while the ratoons received one top-dressing of 160 lb. sulphate of ammonia per acre one month after ratooning.

Growth.—Under the dry conditions in September the ratoons came away poorly, but improved considerably after the rain in mid-October, and grew well until checked by dry weather during the next few weeks; after a fall of 2 inches during the latter half of December, followed by 8·9 inches in January and 4 inches in February, good growth was made for those months, but a further check was caused by dry conditions in March. Further growth was made after the April rains, but as the atmosphere was more or less cool this was slow.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sum of Squares.	Mean Square.	Half $\log_e$ (Mean Square).
Blocks	5	68·66	13·77	..
Subsoiling	1	0·29	0·29	0·5324
Drill-subsoiling	1	3·23	3·23	1·7376
Hand *v.* machine planting	1	0·31	0·31	0·5658
Errors	15	17·61	1·17	1·2298
Total	23	90·30	..	..

Work of the Southern Sugar Experiment Station—continued.

Crop Yields.

—	Subsoiled.	Non-subsoiled.	Subsoiled in Drill.	Non-subsoiled in Drill.	Hand-planted.	Machine-planted.
Cane, tons per acre	**11.62**	**11.83**	**11.36**	**12.09**	**11.84**	**11.61**
Cane, percentage of mean yield	99·1	100·9	96·9	103·1	101·0	99·0
C.C.S., tons per acre	**1.76**	**1.79**	**1.72**	**1.83**	**1.79**	**1.76**

Standard Error .. .. **2.66** per cent.

DISCUSSION.

With this experiment, an attempt was made to determine the value of subsoiling on the red volcanic loam of the Bundaberg area. Due to the failure of the plant crop, no returns were obtained last year, and the ratoons show no benefits from the treatments under review.

As the result of soil studies carried out during the past year, it is now quite clear why a shallow-rooted variety like Q. 813 is not benefited by deep cultivation on this soil type; it is possible, however, that this statement would not hold for a vigorous-rooted cane.

SUBSOIL TRIAL COMBINED WITH FERTILIZING (Plant Crop).

Plan and Crop Yields.

	A	B	B	B	A	A	
(1)	24.38	24.96	21.50	21.31	27.45	26.30	
(2)	3.75	3.85	3.27	3.19	4.28	3.38	
(1)	16.51	19.39	12.09	13.44	16.23	16.51	Subsoiled at ploughing out.
(2)	2.35	2.88	1.76	2.04	2.45	2.48	
(1)	12.67	12.86	13.25	12.29	12.19	14.21	
(2)	1.82	1.94	1.93	1.85	1.88	2.11	
(1)	12.49	12.29	11.52	12.49	9.40	12.29	Subsoiled at ploughing out.
(2)	1.94	1.84	1.73	1.91	1.42	1.82	
(1)	13.06	12.49	12.29	11.71	14.40	13.06	
(2)	1.96	1.87	1.86	1.86	2.16	1.97	

Subsoiled at cross-ploughing. Subsoiled at cross-ploughing.

(1) Cane, tons per acre. (2) C.C.S., tons per acre.

Block.—D.

Variety.—Q. 813.

Harvested. — October, 1933.

System of Replication.—Randomised plots.

Plots.—0·066 acre.

TREATMENTS.

Subsoiled *v.* non-subsoiled as indicated.

(**A**) Fertilised with 200 lb. muriate of potash, 150 lb. superphosphate in drills at planting.

(**B**) No fertilizer.

(**A**) Plots received top-dressing of 150 lb. sulphate of ammonia per acre in late spring.

Cultivation.—The stools from the previous crop were ploughed out and portions subsoiled according to plan in December, 1931, and cross-ploughed and subsoiled in January, 1932; after receiving two further ploughings the cane was planted in September, 1932.

Growth.—The cane was planted during the last week in September, 1933; the soil being dry, there was little movement in the plants till after the rain in mid-October. The strike was good and the cane grew vigorously for a couple of weeks, but was checked by dry weather from November to mid-December; after good rain in the third week of the latter month rapid growth was made and maintained during the next eight or nine weeks, but was again checked by dry conditions in March; following the April rains, good progress was made for a few weeks until retarded by cool weather.

Work of the Southern Sugar Experiment Station—continued.

Crop Yields.

—	No Fertilizer.	150lb. sulph. amm., 150lb. superphosphate, 200lb. muriate of potash.	Subsoiled. (a) Single.	Subsoiled. (b) Double.	Non-subsoiled.
Cane, tons per acre	14.93	16.08	15.12	14.38	16.34
C.C.S. in cane, per cent.	15.06	14.83	15.12	14.93	14.76
C.C.S., tons per acre	2.25	2.38	2.29	2.15	2.41

DISCUSSION.

In this trial also, no advantages have been gained from subsoiling; indeed, the effect appears to have been detrimental, although the yield variations may be accounted for by marked irregularities in fertility within the block.

Fertilizer has been of little benefit, due, no doubt, to the decidedly unfavourable growing conditions experienced over the past two seasons.

MOLASSES TRIAL (Plant Crop).

Plan and Crop Yields.

7 tons molasses per acre.	5 tons molasses per acre.	3 tons molasses per acre.
(1) 13.27	13.12	12.12
(2) 2.03	1.96	1.76

(1) Cane, tons per acre.
(2) C.C.S., tons per acre.

Block.—C1.
Variety.—Q. 813.
Harvested.—September, 1933.
Age of Crop.—11 months.
Plots.—0·58 acre.

TREATMENTS.

Molasses applied broadcast at different rates per acre.

Cultivation.—The previous crop was harvested in August, 1931, and the molasses applied in December, but, owing to dry weather, lay on the surface till after rain in mid-January, 1932, when it was turned under, together with a good quantity of young ratoon cane about 18 inches to 2 feet high. It was intended to have the plots planted in March, but continuous dry conditions retarding the decomposition of the old stools and cane hindered the planting at that time. After receiving two further cross-ploughings and harrowings the cane was planted after a good fall of rain in October.

Growth.—The cane germinated well, but growth was checked by dry weather during November to mid-December; after good rains further growth was made during the next eight weeks and again retarded by dry conditions in March; good progress was made after the April rains, but was checked by cool conditions in May.

Crop Yields.

	Molasses (per Acre). 3 Tons.	5 Tons.	7 Tons.
Cane, tons per acre	12.12	13.12	13.27
C.C.S. in cane, per cent.	14.51	14.98	15.17
C.C.S., tons per acre	1.76	1.96	2.03

Work of the Southern Sugar Experiment Station—continued.

MOLASSES TRIAL (Plant Crop).

Plan and Crop Yields.

8 tons molasses per acre.	6 tons molasses per acre.	4 tons molasses per acre.
(1) 13.33	13.39	12.82
(2) 2.06	2.03	1.97

Block.—A1.

Variety.—Q. 813.

Harvested.—October, 1933.

Age of Crop.—13 months.

Plots.—·725 acre.

TREATMENTS.

Molasses applied broadcast at different rates per acre.

Cultivation and Growth.—As for molasses trial on C1.

Crop Yields.

	Molasses (per Acre).		
	4 Tons.	6 Tons.	8 Tons.
Cane, tons per acre	12.82	13.39	13.33
C.C.S. in cane, per cent.	15.40	15.21	15.45
C.C.S., tons per acre	1.97	2.03	2.06

DISCUSSION.

In the two trials reported above, it was hoped to determine the economic value of different applications of molasses on the red volcanic soil. Seasonal conditions were so unfavourable that the benefits of the added molasses can scarcely be detected. It is hoped that improved climatic factors will provide more valuable results with the ratoon crops.

FERTILIZER TRIAL—DIFFERENT FORMS OF PHOSPHATES AND AMOUNTS OF POTASH (First Ratoon Crop.)

Blocks. Plan and Crop Yields.

	2K	Ps 2K	Pm 1K	1K	Pm 2K	Ps 1K
I.	(1) 12.34	12.34	5.68	9.88	9.35	8.82
	(2) 1.82	1.89	.82	1.54	1.33	1.36
	Pm 2K	Ps 1K	Pm 1K	2K	Ps 2K	1K
II.	(1) 9.88	10.41	8.82	9.35	9.17	7.94
	(2) 1.48	1.51	1.35	1.44	1.50	1.16
	Pm 1K	1K	Pm 2K	Ps 1K	Ps 2K	2K
III.	(1) 8.82	7.75	9.00	9.70	9.49	10.23
	(2) 1.33	1.18	1.37	1.52	1.47	1.46
	Ps 2K	Pm 1K	1K	Pm 2K	2K	Ps 1K
IV.	(1) 9.35	9.17	5.69	7.05	7.75	7.41
	(2) 1.41	1.30	.84	1.09	1.19	1.09
	Pm 2K	2K	Ps 1K	Pm 1K	1K	Ps 2K
V.	(1) 10.23	7.57	6.00	7.23	7.23	8.82
	(2) 1.55	1.16	.85	1.07	1.11	1.32

(1) Cane, tons per acre. (2) C.C.S., tons per acre.

Block.—B2.

Variety.—Q. 813.

Harvested.—October, 1933.

Age of Crop.—14 months.

System of Replication.—Five randomised blocks.

Plots.—0·071 acre.

TREATMENTS.

Plant Cane.—

1K—150 lb. muriate of potash per acre.

2K—300 lb. muriate of potash per acre.

Ps—200 lb. superphosphate, 75 lb. sulphate of ammonia per acre.

Pm—314 lb. meatworks manure per acre.

Ratoons.—No further mixed fertilizer, but all plots received 160 lb. sulphate of ammonia per acre.

Work of the Southern Sugar Experiment Station—continued.

Cultivation.—Owing to the effects of continuous dry weather, the plant crop was harvested as revenue in August, 1932, and the cane ratooned with the subsoiler four times per row, twice as soon as the cane was cut, and twice a month later; the soil was very dry at the first ratooning, and broke up in large lumps. Fertilizers as per plan were applied to the plant crop, while the ratoons received one top-dressing of 160 lb. sulphate of ammonia per acre two weeks after ratooning.

Growth.—The cane ratooned poorly, improving a little after the rain in October, but many of the stools had died out and the ratoon generally was not satisfactory. Good growth was made after the October rain, but was checked by dry conditions during November to mid-December. It moved away again in response to the rain during the latter half of December; a further check was caused by hot, dry weather in March, and though the April rains had a beneficial effect, portions of this block did not respond in the same way as other portions of the Station. Growth was again retarded by cool conditions in May, and though all through the winter there was a good supply of moisture in the soil, very little was added to the tonnages during that period.

Analysis of Variance.

Due to—	Degrees of Freedom.	Sums of Squares.	Mean Square.	Half Log_e (Mean Square).
Blocks	4	19·51	4·88	..
Potash	1	15·24	15·24	1·3619
Phosphates	2	2·44	1·22	0·0995
Errors	22	40·97	1·86	0·3103
Total	29	78·16	..	..

Crop Yields.

—	Muriate of Potash.		Phosphates.		
	150 lb.	300 lb.	None.	200 lb. superphosphate + 75 lb. sulphate ammonia.	314 lb. meatworks manure.
Cane, tons per acre	**8.04**	**9.46**	**8.57**	**9.15**	**8.52**
Cane, percentage of mean yield	91·9	108·1	98·0	104·6	97·4
C.C.S. in cane, per cent.	**14.95**	**15.14**	**15.05**	**15.21**	**14.89**
C.C.S., tons per acre	**1.20**	**1.43**	**1.29**	**1.39**	**1.27**
Standard Error	**4.02** per cent.		**4.92** per cent.		

DISCUSSION.

Due to the crop failure, the plant cane was not harvested as an experiment. The ratoons were so poor also that little data of value can be drawn from the yields. The double dressing of potash was superior to the single, as would be expected on this potash-deficient soil. Both forms of phosphate were quite ineffective in producing increased yields.

Work of the Southern Sugar Experiment Station—continued.

VARIETAL TRIAL (Plant Crop).

Plan and Crop Yields.

POJ 2725 19.50	Q 813 11.25	POJ 234 11.18	Q 813 11.06	Co 290 17.63
Q 813 11.46	Co 290 26.25	Co 281 14.57	Manoa 304 10.83	Q 813 9.75
POJ 234 14.01	POJ 2725 15.95	Q 813 10.23	Co 290 26.25	POJ 2725 15.42
Co 290 24.59	Q 813 9.37	Manoa 304 9.75	Q 813 10.82	POJ 234 13.25
Q 813 7.94	POJ 234 15.63	Co 290 23.25	26 C 188 12.56	Q 813 9.28
26 C 188 11.76	Manoa 304 7.12	Q 813 6.97	POJ 234 15.00	Co 290 18.83
Co 290 22.50	Q 813 7.03	POJ 2725 16.50	Q 813 6.75	Co 281 15.57

Block.—B1.

Harvested.—August to October.

Age of Crop.—10-12 months.

Plots.—1/30 acre.

TREATMENTS.

Cultivation.—The stools from one-half of the block were ploughed out in October, 1931, and the land prepared for seedlings, while the other half was ploughed out in August, 1932; the entire block thereafter received two further cross-ploughings and harrowings, and the varieties were planted in mid-October, 1932, after being soaked in water for 36 hours. The soil was in a fairly moist condition.

Growth.—All varieties germinated well, Q. 813 being the first through, followed by Co. 290, P.O.J. 234, and P.O.J. 2725; these four canes were through within a fortnight after planting, while all the rest came through during the next week. M. 304 was the last and somewhat poorer in germination than the others. Good progress was made by all canes until checked by dry conditions in November, Co. 290, P.O.J. 234, and P.O.J. 2725 standing up to the dry weather best. After the rain in mid-December a further period of good growth was made till retarded by dry weather in March. Further growth was made after the rain in April, but as atmospheric conditions were cool the progress was slow.

Crop Yields.

Variety.	No. of Plots.	Cane, tons per acre.	Cane, percentage of Standard Yield.
Co. 290	7	**22.76**	244
P.O.J 2725	4	**16.84**	181
Co. 281	2	**15.07**	162
P.O.J 234	5	**13.81**	148
26 C. 188	2	**12.16**	130
Q. 813	12	**9.33**	100
Manoa 304	3	**9.23**	99

DISCUSSION.

During the past four years the Pathologist and staff have conducted several gumming-résistance trials to determine the value of a selection of recently imported canes. Those which had attained a satisfactory degree of resistance were submitted to an observational yield trial, which was planted in October, 1932, and the results of this trial

Work of the Southern Sugar Experiment Station—continued.

are recorded above. All but one of the varieties under review outyielded the standard, Q. 813. Co. 290, P.O.J. 2725, and P.O.J. 234 appear to show decided promise, and the produce from these plots was planted out in further yield trials on selected farms.

Owing to the erratic manner in which the plots were harvested and the immature state of the crop, no reliable c.c.s. determinations were made. Results do suggest, however, that the three canes mentioned above show good sugar content, and are rather early maturers. The following percentages suggest, also, that the canes are not excessively high in fibre :—

P.O.J. 2725	10·2 per cent.
P.O.J. 234	11·9 per cent.
Co. 281	12·5 per cent.
Co. 290	11·1 per cent.

Co. 290 differs from the earlier Co. canes in that it produces a much heavier stick, and inclines more to the characteristics of the "noble" canes.

Such canes as prove satisfactory in the trials now under way will be made available for further farm propagation plots next year, and it is confidently anticipated that one or two will provide the vigorous, disease-resistant canes of good quality so seriously lacking in the southern areas.

TRIAL WITH NEW LEGUMES.

A selection of recently imported legumes was planted out at this Station some three years ago. Growing conditions were anything but favourable during the period under review, and those species which have survived must certainly possess a definite degree of drought resistance.

Two species were selected as showing decided promise. These are *Crotolaria goreensis* (a species of "Rattle Pod") and *Canavalia ensiformis* ("Jack Bean"). The following are the notes recorded during the past season :—

Crotolaria goreensis.—The seed was sown broadcast at the rate of about 13 lb. per acre towards the end of November, 1932, the soil being fairly dry at the time. There was a poor germination, and it appeared as though the crop would be a failure; but after the rain in mid-December the remainder of the seed came away well, and, together with what had previously come through, grew vigorously during the next two months. Being of a bushy nature with a good supply of foliage, the ground was quickly covered. The plants suffered a check during March, but recovered quickly after the rain in April, and grew to about 3 feet, flowering profusely and seeding heavily in May. After the seed matured the foliage fell and the plants appeared to be dying out, but early in June they began to send out fresh shoots, and in a short time the plants were quite green again.

From its behaviour here this plant should prove a good green manure, since it provides a good cover and is very easy to plough under when mature.

Canavalia ensiformis.—The seed was sown broadcast at the rate of about 17 lb. per acre towards the end of November, 1932, but there was no germination till after the rain in December, when a fair stand was obtained; this would probably have been better had the seed been sown in drills. The plants grew well during the following two months and covered the ground in a short time. The foliage is broad and plentiful and the plant of a bushy nature. It flowered and podded towards the end of February, but, the following month being dry, very few of the seed reached maturity. The plants suffered considerably from the dry weather. They revived again after the rain in April and flowered a second time, but only sparsely, and few seeds were obtained.

Work of the Southern Sugar Experiment Station—continued.

This might also prove a good green manure crops as it provides a good cover and turns under very easily. The plant is evidently a perennial, since after seeding the second time there was no sign of dying out or casting of leaves, and at time of ploughing in July was throwing out fresh shoots.

Crop Yields.

An estimate of the crop yields of these species was made, and samples of the entire plants were later submitted to analysis, with the following results :—

—	*Crotolaria goreensis.*	*Canavalia ensiformis.*
Yield per acre (green matter)	16·8 tons	11·8 tons
Nitrogen	274 lb. per acre	133 lb. per acre
Phosphoric acid	28 lb. per acre	22 lb. per acre
Potash	102 lb. per acre	113 lb. per acre

Though these species would be of limited value during a short fallow, they appear to possess definite promise as cover crops for long fallow. They are now being planted out with a view to securing further seed supplies, which will then be made available to desirous growers.

DETAILS OF ANALYTICAL WORK PERFORMED AT THE LABORATORY OF THE SOUTHERN SUGAR EXPERIMENT STATION, BUNDABERG, FROM 1st NOVEMBER, 1932, TO 31st OCTOBER, 1933.

Materials.	Number of Analyses.
Sugar-canes and juices for growers	673
Sugar-canes and juices for Agricultural Show, Bundaberg	218
Sugar-canes and juices for Agricultural Show, Maryborough	47
Sugar-canes and juices for Agricultural Show, Pialba	50
Sugar-canes and juices for Experiment Station	101
Total	1,089

TOTAL TONNAGE OF CANE HARVESTED FROM THE SOUTHERN SUGAR EXPERIMENT STATION, BUNDABERG, DURING 1933.

	Tons.
Cane sent to mill	325·9
Cane used for plants	14·0
Total	339·9

Nature of Crop—

	Tons.
Plant cane	161·3
First ratoon (standover)	117·9
First ratoon	60·7

Tonnages—

	Per cent.
Q. 813	56·8
Co. varieties	15·9
Other varieties	27·3

Area harvested	21 acres
Average tons per acre	16·18

Division of Pathology.

Mr. Arthur F. Bell, Pathologist.

The disease situation during the period under review has been greatly influenced by the unusual climatic conditions which have prevailed throughout the whole State. With the exception of red stripe and downy mildew in the Lower Burdekin district, these conditions have been such as to minimise both the rate of spread and the effects of the more important diseases, and, as a natural corollary, of course, our gumming and leaf-scald disease resistance trials have been adversely affected. The most noteworthy advance made during the year has been the final determination of the insect responsible for the spread of Fiji disease, together with the understanding of the conditions which govern the rate of spread of the disease. This information should prove of the greatest possible value in view of the apparently general susceptibility of the vigorously growing canes of the Kassoer "blood line." Important progress has also been made in the development of technique for the conduct of varietal resistance trials and in the preliminary studies of the economic importance of the newly described pseudo-scald or chlorotic streak disease. All available evidence strongly indicates that this disease is of first-rate importance, and emphasises the necessity for the institution of controlled production of healthy planting material in each mill district of North Queensland.

Variety Introductions.

Only two foreign cane varieties were introduced during the year—viz., C.P. 807 and C.P.H. 139. Both are seedlings raised by the United States Government at Canal Point, Florida, and are very promising canes under the subtropical conditions of Louisiana.

Resistance Trials.

The policy of extensive resistance trials to determine varietal resistance or susceptibility to the diseases of any particular district before distributing new varieties is being gradually extended as suitable methods are developed for each disease. At the present juncture trials to determine resistance to the following diseases are being carried out:—Gumming, leaf-scald, red stripe, downy mildew, Fiji, mosaic, and root rots of the *Marasmius* type. This policy is already proving of the greatest value in predetermining the suitability of individual varieties for particular localities, in contrast to older methods of trial and error, under which a variety might be planted to extensive areas before its susceptibility to a particular disease became apparent. A striking example of the economic value of this systematic procedure is furnished by the variety P.O.J. 2940 in the Lower Burdekin district. A small quantity of the variety was taken into the district last year for trial purposes, but, while the area planted to this outstandingly vigorous cane is still only a fraction of an acre, it has been established by means of a disease-resistance trial that further propagation is unthinkable. Had this variety been introduced to two or three disease-free farms without being subjected to resistance trials, its high vigour would undoubtedly have ensured its very rapid planting to hundreds of acres in all parts of the district. Downy mildew being present on or near the majority of the farms, this disease would then have literally swept through the fields of this variety and have caused very great losses.

Resistance trials have now been extended to include the determination of "family" resistance to gumming and leaf-scald diseases, in order to ascertain whether any particular cross is likely to yield progeny which will include a high percentage of individuals resistant to either or both of these major diseases. In order to facilitate this work insofar as leaf-scald disease is concerned, and to enable larger numbers of seedlings to be treated, attention is being directed towards the possibilities of determining such mass response in the young seedling stage.

A very interesting (and disconcerting) result of our varietal resistance trials is the increasing evidence that the higher-numbered P.O.J. canes of the Kassoer blood line are generally highly susceptible to red stripe, downy mildew, and Fiji diseases. Indeed, they introduce a new order of susceptibility. On the other hand, they are generally highly resistant to gumming disease, as well as to mosaic.

Division of Pathology—continued.

"Pseudo-scald" or Chlorotic Streak Disease.

"Pseudo-scald" was the term provisionally applied to a disease described in the Annual Report for 1929, at which time it was not definitely known whether it was distinct from leaf-scald or not. In the interim a considerable amount of attention has been paid to the disease, and, as it has been conclusively demonstrated that there is no question of the separate identity of these two diseases, it is proposed to adopt the name since used in Hawaii—viz., Chlorotic Streak. Last year a small stock of Badila cane, known to be free from leaf-scald, was obtained and planted in the Pathology plot after one-half of the setts had been subjected to warm water treatment. The results of this small trial were particularly striking; the treated cane gew vigorously and appeared disease-free throughout the life of the crop, while the untreated cane bore the typical symptoms on all but two stools, was sickly and stunted in appearance, and the yield was less than 40 per cent. of that of the treated cane. Naturally, definite conclusions could not be drawn from a small trial conducted in a latitude where Badila is not widely grown, but the results were such as to demand further trials immediately. Accordingly two field trials with the variety Badila have been set out, one (Tully) comparing diseased and warm water treated cane, and the other (Mulgrave) comparing local diseased cane and healthy cane from the Tableland nursery. These trials were planted in August and July respectively, and already striking differences are apparent between the diseased and healthy or treated cane.

The symptoms of the disease were fully described in an article recently published in the second issue of the *Cane Growers Quarterly Bulletin*. In addition to Badila (the variety chiefly affected), the disease has also been observed in H.Q. 426 (Clark's Seedling), H.Q. 409, S.J. 4, Korpi, S.C. 12/4, P.O.J. 2878, P.O.J. 2722, P.O.J. 2875, and D. I. 52, and doubtless will be found in numerous other varieties as opportunities for observation present themselves. Symptoms have been readily observable in North Queensland during the past two months, particularly in the young ratoon cane, and a rapid survey indicates that the disease is much more prevalent in the highest rainfall sections, and particularly in low-lying country. Attempts to transmit the disease by knife infection have so far been without result, and secondary transmission in the field would not appear to be rapid, as a rule, thus permitting the disease to be controlled by the use of healthy planting material. The question of possible insect transmission of the disease is being investigated in co-operation with the Division of Entomology.

It has been noted that the variety S.J. 4, in addition to the usual symptoms of chlorotic streak disease, commonly bears leaf markings which resemble those of chlorotic streak in colour, outline, and width, but differ inasmuch as they are borne at the tips of the leaves only, and, in addition, are much more numerous. Cuttings from stalks bearing such striped leaves were subjected to the warm water treatment as used in the case of chlorotic streak, but no difference was noted between the treated and untreated cane. It is, therefore, concluded that these characteristic markings of the leaf tip are not symptoms of chlorotic streak disease.

Fiji Disease.

Fiji disease has never been widely distributed in Queensland and until recently had not assumed major importance. However, with the discovery that certain new canes of excellent promise in the gumming-resistance trials were, unfortunately, extremely susceptible to Fiji disease, the presence of the latter assumed a new aspect, and it became necessary to have precise information regarding the mode and the conditions governing transmission under natural conditions. This investigation was carried out with the co-operation of Mr. R. W. Mungomery, of the Division of Entomology, and was successful in demonstrating that an insect vector—the sugar-cane leaf hopper *Perkinsiella saccharicida* Kirk.—was the natural transmitting agent. The entomological aspects of this work are more fully discussed on page 68; from the pathological point of view, several important points have emerged. It has been shown that the incidence of the leaf hopper population

Division of Pathology—continued.

is highly positively correlated with the vigour of the cane, and, hence, rich river flats, for example, are not desirable sources of plants, while susceptible varieties, if grown, should be restricted to the poorer soils. The prolonged period of latency before the development of symptoms by plants infected in the late autumn makes it essential that for the selection of fields for plants there must be made at least two inspections, of which the second should be carried out not later than March and not less than three months later than the first inspection. All roguing of diseased plants should be completed before the leaf hopper population assumes significant proportions. Finally, in the matter of disease-resistance trials it would appear essential that the source of infection should be a tolerant variety, that the trial be planted under conditions favourable for rapid growth, and that it be planted relatively late in the season so that the diseased plants are still succulent and attractive to insects at the period of increase of leaf hopper population. Based on the results of this investigation, a Fiji disease resistance trial has now been laid out under conditions which it is believed will ensure success; the varieties planted include all known blood lines with the exception of *Saccharum robustum*.

The general situation in regard to Fiji disease has improved considerably during the past two seasons, due to adverse weather conditions, which not only were responsible for decreased numbers of the insect vector but favoured the early death of diseased plants and so reduced the sources of infection.

Dwarf Disease.

This new disease has been recorded on eight more properties in the Homebush area, making the total number of known infected farms sixteen, while a further variety (Malagache) has been added to the list of the varieties in which the disease has been observed. As previously reported, all the characteristics of this disease strongly suggest the virus type, with the concomitant probability of insect transmission in the field. The services of Mr. W. A. McDougall, Assistant Entomologist stationed at the Mackay Experiment Station, have been co-opted for the investigation of this disease, and he has already initiated preliminary experiments in an attempt to determine methods of mechanical or insect transmission. Field observational trials are also being conducted, and in this connection it is interesting and reassuring to note that secondary spread appears to be restricted to a particular type of country.

Gumming Disease.

Owing to the almost entire absence of the normal summer wet season in the southern districts of Queensland, there was very little secondary spread of gumming disease, and, following the extremely droughty conditions of the previous year, there is relatively little evidence of the disease, even in susceptible varieties. Furthermore, owing to the warm wet winter there has not been the usual pronounced check in growth and, consequently, there has been a greatly reduced effect upon such cane as was diseased. By the same token, conditions have not been favourable for the conduct of gumming-resistance trials, and conclusions regarding the current trial cannot be drawn with the precision desired. Of the varieties under test, no death or oozing of gum occurred in 26 C. 148, Hawaiian Uba (?), P.O.J. 2725, P.O.J. 2875, and P.O.J. 2940, while no death and only slight oozing was observed in S.J. 52A and P.O.J. 234. All these canes would appear to be of sufficiently high resistance to be grown commercially without special precautions, but owing to the generally unsatisfactory climatic conditions prevailing throughout the progress of the trial, all canes of any promise have been included in the new season's trials for confirmation of results. The results with P.O.J. 234, P.O.J. 2725, and P.O.J. 2875, however, have been confirmed by independent trials conducted by the C.S.R. Company.

The first family resistance trial was conducted with a small amount of material available from the first batch of seedlings raised at the Bundaberg Sugar Experiment Station. Only four crosses were available in sufficient numbers to permit of any

Division of Pathology—continued.

indications as to the standard of resistance likely to be expected from their progeny. Two setts of each seedling were planted, between guard rows as usual, the final results at the conclusion of the trial on 15th October being as follows :—

Cross.	Number of Stools.	Stools with no Symptoms.	Stools with Leaf Symptoms only.	Stools with Oozing but no Death.	Stools with Dead Stalks.
P.O.J. 2940 × S.C. 12/4	68	47	14	3	4
N.G. 15 × S.C. 12/4	46	26	7	3	11
N.G. 24 × R.P. 6	110	43	34	10	33
S.J. 4 × S.C. 12/4	130	52	26	13	39

Of these crosses, it would seem that only the first shows sufficiently high general resistance to warrant further trial in these districts. Two further trials have been planted for the ensuing season—one at Bundaberg containing thirty varieties, and a second at Bli Bli containing fourteen varieties and over 600 seedlings for the determination of family resistance.

In order to make a preliminary selection and to provide planting material for farm trials, an observational yield trial was conducted with seven gumming-resistant varieties. This trial was conducted at the Bundaberg Experiment Station and is fully reported on page 51. It will be seen that the variety Co. 290 has yielded remarkably well in view of the adverse season ; this variety, together with P.O.J. 2725, P.O.J. 234, and Co. 281, has greatly outyielded Q. 813 under the conditions of the trial, while the sugar content was quite satisfactory. These four varieties, together with the resistant varieties P.O.J. 979, P.O.J. 2379, P.O.J. 2875, and P.O.J. 2878, have been set out in a series of farm yield trials, and it is confidently expected that they will yield satisfactory substitutes for the susceptible standard varieties D. 1135 and M, 1900 S.

Red Stripe.

Mainly due to the stunting and growth-checking effects of almost unprecedentedly dry spring weather, the incidence of red stripe top rot was greater in the Johnstone and Mulgrave districts than it has been since the inception of this Division.

Fortunately, by far the greater proportion of death of shoots occurred early in the season, and so the compensation factor, due to increased growth of the remaining shoots, had adequate time in which to operate. The effect of this compensation factor may be deduced from results kindly furnished from the Goondi Mill, which is situated in one of the areas of greatest intensity of red stripe. The yield per acre for the standard variety Badila (plant and ratoon) is tabulated for the last five years and strongly indicates that the ultimate effect of the top rot upon the crop results has been almost negligible. These results should be sufficient to combat those wild assertions that Badila is "running out" on account of red stripe top rot :—

Year.	Yield in Tons per Acre.
1930	.. 22·8
1931	.. 25·1
1932	.. 22·0
1933	.. 26 (approx. estimate)

In the Johnstone district early planting was a conspicuous success in the control of the disease. An excellent example of this form of control was observed in two adjacent fields at the Eight-mile in the South Johnstone Mill area. These two fields were separated only by a headland, had been cultivated on the same general lines, and had been given identical fertilizer treatment. The one field, which was considered by the field staff of the mill to be the worst affected in the district, was planted in August, 1932, and the amount of death was estimated at 39 per cent. of the stalks ; the other field, planted

Division of Pathology—continued.

in April, 1932, had only 2·5 per cent. of dead stalks. Nevertheless, owing to the death taking place relatively early in the season, the compensation factor must have been very considerable, as the owner reports that the yield per acre in the 39-per-cent.-killed block was greater than in any previous year. This method of avoiding the disease did not prove efficacious this year in the Mulgrave area in soils of low moisture, the early part of the season being so dry as to offset any advantage gained by early planting.

A successful varietal resistance trial was conducted at the South Johnstone Experiment Station. The trial was planted at the end of August, the plants being set close together in the drill, while every third row was a guard row of the highly susceptible P.O.J. 2714. Natural infection was relied upon, and weather conditions proved very favourable. The results obtained, when the trial was concluded at the end of March, were as set out hereunder :—

Variety.	Stalks.	Dead Stalks.	Per cent. Dead Stalks.
H.Q. 426	78	..	..
S.J. 4D	144	..	..
S.J. 1D	221	1	·4
Oramboo	122	1	·8
B. 208	91	5	5·5
Badila	**111**	**11**	**10**
S.J. 3D	151	25	16·6
S.J. 2D	160	30	18·8
P.O.J. 2940	82	17	20·7
P.O.J. 2878	302	65	21·5

Four varieties (H.Q. 426, B. 208, Badila, and P.O.J. 2878) whose field reaction to this disease is well known were included in addition to P.O.J. 2714 for reference purposes. In the field these four varieties exhibit four distinct grades of resistance or susceptibility, and it was reassuring to find these grades exactly reproduced in the trial. The P.O.J. 2714 in the guard rows suffered the greatest amount of death, but the percentage could not be determined with accuracy; the seedling S.J. 7 was included in a small leaf-scald trial immediately adjacent to this trial and, therefore, might be treated as being included therein. The amount of death of stalks in this variety was 10 per cent. The results of the trial are self-explanatory, bearing in mind the fact that Badila represents the approximate limit of susceptibility allowable in varieties planted in the spring. The performance of the vigorous P.O.J. 2940 is disappointing and, coupled with its high susceptibility to downy mildew disease, it is doubtful whether it should be propagated further in North Queensland.

A second resistance trial was set out in the Mackay district, but no infection resulted naturally, and two series of artificial inoculations proved fruitless. This result serves to confirm our previous experience that red stripe will inevitably appear if climatic conditions are favourable, and artificial inoculation is useless if they are not.

Downy Mildew.

Downy mildew continues to be the major disease of the Lower Burdekin area and is more prevalent at present than for some years past. This is due to two factors—the warm wet winter of 1933 and the planting of the variety P.O.J. 2878. In normal seasons there is little or no secondary spread of the disease during the dry cool months of June-September, but a very considerable rate of spread has been maintained throughout the

Division of Pathology—continued.

past few months. The explanation of this state of affairs is made readily apparent by reference to the attached table, which sets out the rainfalls registered at Kalamia Estate for the past six years :—

Month.	Rainfall in Inches.					
	1928.	1929.	1930.	1931.	1932.	1933.
June	·55	3·04	1·22	·17	·24	4·40
July	·01	·02	·14	·01	·11	2·23
August	Nil	·01	Nil	·24	·22	·80
September	·01	·32	Nil	·03	·03	1·72

It will be seen that the rainfall for this period has been greatly above average during the current year, giving the warm humid conditions necessary for the production and germination of the spores of the fungus causing the disease.

The first downy mildew resistance trial was carried out with the co-operation of Kalamia Estate. Since the chief object of the trial was the development of a method for the conduct of such trials, the number of varieties was restricted. Freshly stripped cuttings were exposed to bud infection by spores of the causal fungus before planting, while diseased stools were scattered through the plot to provide subsequent sources of infection. This trial will be continued until next winter, but it has already yielded interesting results and indicates the efficacy of the method employed. The degree of infection so far recorded in each variety is as follows :—H.Q. 426, nil ; Badila, nil ; P.O.J. 2725, nil ; B. 208, 15 per cent. ; P.O.J. 2878, 25 per cent. ; P.O.J. 2940, 85 per cent. The four varieties H.Q. 426, Badila, B. 208, and P.O.J. 2878 have responded as anticipated. Field performance has indicated that P.O.J. 2878 is too susceptible to be grown where downy mildew disease is prevalent, and, consequently, it is obvious from this trial that P.O.J. 2940 is far too susceptible to warrant a moment's consideration as a possible cane for the Lower Burdekin area.

Root Disease.

Consideration has been given to a disease which appears to be a root disease of the *Marasmius* type. This disease has been observed in restricted areas in different parts of the State, but has been observed most frequently in the Bundaberg district. It is associated with dark red spots upon the leaves, which commence as small specks, but which may coalesce to give a general discoloration of all or portion of the leaf. The spots are equally visible on both sides of the leaves and are more common on older than younger leaves. They do not have necrotic centres, but whole leaves may die. The leaf sheaths carry an abnormal red blotching of the inner surface and in advanced cases may be cemented together by a whitish mycelium, but this cementing may occur unaccompanied by leaf spotting. In practically every instance stalks bearing these reddish leaf spots show, on dissection, a dry brownish red rot at the base of the stalk, together with a considerable rotting of the roots. Diseased and healthy shoots are very commonly found in the one stool ; the diseased stalks in such cases have a tendency to arise from an end bud, while diseased secondary shoots are almost invariably found to arise from a diseased primary shoot. Various aspects of this disease and possible contributory factors are being investigated by means of field trials which include a resistance trial and type of planting material, soil sterilization, soil amendment, and sett treatment trials.

Leaf-scald Disease.

A resistance trial composed of the progeny of several trial marriages was carried out at Meringa. Cuttings were inoculated by smearing a suspension of five strains of *B. albilineans* upon the freshly cut surfaces. Owing to the dry conditions, long cuttings

Division of Pathology—continued.

were used. Conditions remained exceedingly dry and germination was very variable, and a large number of stools perished shortly after coming through the ground. Of the remaining stools, very few bore symptoms of leaf-scald. It may, therefore, be a legitimate assumption that failure to germinate was in a considerable part due to the inoculation of susceptible canes. The following table sets out the numbers of setts which failed to germinate or produced sickly stools which soon died :—

Cross.	Setts Planted.	Failed to germinate or produced rapidly dying Stools.	Percentage.
P.O.J. 2878 × S.C. 12/4	100	1	1
P.O.J. 2878 × S.W. 499	180	7	4
N.G. 15 × S.C. 12/4	95	5	5
N.G. 15 × Pompey	120	11	9
N.G. 15 × H.Q. 409	40	5	12·5
Oramboo × Q. 813	104	5	5
Oramboo × H.Q. 409	70	11	16
N.G. 24 × S.C. 12/4	90	3	3
N.G. 24 × E.K. 28	90	22	24

Two cuttings of each seedling were planted, except in the case of second-year seedlings (N.G. 15 × S.C. 12/4, N.G. 24 × E.K. 28, and N.G. 24 × S.C. 12/4), when five cuttings were planted. When compared with last year's trial and the supplementary trial set out below, it will be seen that the order of resistance appears reasonably consistent.

A supplementary trial was conducted by utilising the original seedling block, which was exposed to natural infection and mechanical infection due to the use of unsterilized knives in cutting out selected stalks and juice sampling. This trial has yielded valuable positive results, but in trials of such a nature it is considered that the negative results—i.e., apparent high resistance of certain crosses—require confirmatory trials. The results are set out below :—

Cross.	Number of Seedlings.	Percentage of Diseased Stools.
Badila × S.C. 12/4	1,008	5
Badila × Ewa 371	160	16
Badila × Q. 813	404	Nil
Badila × H.Q. 409	208	21
N.G. 16 × Ewa 371	56	21
N.G. 16 × Q. 813	220	4
N.G. 16 × E.K. 28	56	36
P.O.J. 2878 × S.W. 499	806	4
P.O.J. 2364 × H.Q. 409	488	2
P.O.J. 2364 × S.C. 12/4	370	Nil
Oramboo × Q. 813	564	10
Oramboo × H.Q. 409	142	48
Pompey × D. 1135	104	24
Pompey × N.G. 15	250	54
Uba × W. 4	22	Nil
Daniel Dupont × P.O.J. 2878	430	Nil
B. 208 × S.C. 12/4	60	Nil

Division of Pathology—continued.

The most suitable method of inoculation to be used in connection with trials of varietal resistance to this complex disease is still the subject of experimental investigation. A study of trials in which the smear method of sett inoculation has been used suggests that the apparent "recovery" from the disease may be due to the failure of the inoculum to penetrate to the central eyes, which produce healthy shoots, while the diseased shoots from end eyes soon die under adverse conditions, leaving a healthy plant. In order to overcome this possible objection to sett inoculation, a simple method of pressure inoculation has been devised in the laboratory; this method ensures the penetration of the inoculum to the central eyes even though conditions require the use of long cuttings. Further trials using the method of inoculating growing shoots by means of injections indicate that this method is quite unreliable inasmuch as it is too severe, and positive results are obtained from known highly resistant varieties. The investigation of various methods of inoculation and sources of inoculum is being continued, and a considerable amount of attention is being focussed upon the possibility of ascertaining the mass response of trial marriage progeny by the inoculation of very young original seedlings.

Publications.

The following publications have been issued from the Division during the year :—

Banded (Sectional) Chlorosis Associated with Tangle Top and Death of Sugar-cane. Qld. Agr. Jour. 28 : 5 : pp. 476-483, 1932.

The Control of Sugar-cane Diseases. Proc. Fourth Ann. Conf. Qld. Society of Sugar Cane Technologists, pp. 60-75, 1933.

Dwarf Disease of Sugar Cane. Farm Bulletin No. 8, pp. 1-6, 1933.

Fiji Disease of Sugar Cane and its Transmission. Bulletin No. 4, Div. of Path., pp. 1-28, 1933.

The Spread of Fiji Disease by Insects. Quarterly Bulletin, 1 : 1 : pp. 20-23, 1933.

The Control of Diseases in Young Plant Cane. Quar. Bulletin, 1 : 2 : pp. 49-52, 1933.

What are the Losses Due to Red Stripe (Top Rot) Disease? Quar. Bull., 1 : 2 : pp. 35-37, 1933.

A New Disease of Cane in North Queensland. Quar. Bulletin, 1 : 2 : pp. 42-46, 1933.

In addition, wireless lectures were delivered on the following subjects :—

Dwarf Disease ;

Fiji Disease ;

Leaf-Scald Disease ;

Cane Varieties, the Need for Restricted Numbers on the Farm ;

Control of Diseases in Young Plant Cane.

Division of Entomology.

NORTHERN STATION, MERINGA.

Mr. E. Jarvis, Entomologist.

I have pleasure in reporting that control measures studied during the last twelve months with a view to minimising the tremendous annual loss to the sugar industry from the ravages of root-eating grubs of Scarabæid beetles have again yielded positive results in field experimentation.

The present interest in entomological matters displayed by individuals occupying more or less important positions associated with the manufacture of sugar is very encouraging, and not only have these laymen and the managers of our Northern central mills become thoroughly awakened to a fuller realisation of the possibilities of scientific research in connection with cane-grub control, but a similar spirit of alert inquiry appears to be manifested also by certain directors of commercial firms, some of whom have manufactured various insecticidal compounds in the hope of discovering a solution to the so-called "cane-grub problem."

Fumigation of Cane-grubs.

The success achieved against our cane-grubs last season by the practice of soil fumigation has now placed this control measure on a firm basis, proving beyond doubt the economic value of both carbon bisulphide and paradichlorobenzene. As often pointed out in former reports during past years, these fumigants are effective against root-eating Scarabæid grubs, whether employed separately or mixed together. Economic entomologists in other countries, however, prefer the former and more simple method of application, and in latest research bulletins are recommending the use of dry nodules of paradichlorobenzene for combating the ravages of such Scarabæid grubs, with which they claim to be obtaining high percentages of mortality.

Some interesting results regarding the evaporation of crystals of paradichlor. were published by Z. S. Golovyanko whilst experimenting in Russia against grubs of the forest cockchafer *Melolontha hippocastani* Fabr. in the Darnitza region. He found that varying degrees of concentration of the fumes of this chemical were required for destroying the different instars of grubs of the same species of Scarabæidæ. Young grubs of *Polyphylla* and *Melolontha* were found to be most susceptible to such fumes, being analogous in this respect to adult grubs of closely allied species belonging to the same family and differing only slightly in size. Varying degrees of concentration of these fumes were also found to be necessary when treating the grubs of different families of Coleoptera.

It was noticed, for example, that elaterid and curculionid larvæ proved to be the most resistant to treatment with paradichlorobenzene.

Our field experiments with this fumigant have shown that we can get similar results in Australia, but unfortunately the high cost of labour in Queensland combined with the heavy duty on paradichlor. prohibits its use in dry nodule form for the time being. On the other hand, marked successes have resulted in the Cairns and South Johnstone districts from soil injections of carbon bisulphide, both with and without the admixture of paradichlorobenzene.

Cane farmers supplying the Mulgrave Central Mill this season have placed orders with the managers amounting to £4,000 for purchase of the above fumigants to be used against cane-grubs at the beginning of next year (1934).

Division of Entomology—continued.

Fumigation of Cane-grubs during 1933.

It is interesting to record the following results obtained this year by growers in the Mulgrave area on blocks of cane which they fumigated for cane-grubs under the personal supervision of this Experiment Station. Considering the fact that the cane received a severe check from seven months' drought at the latter end of 1932, and that the rain was exceptionally recurrent during the fumigation season of 1933, thereby interfering with fumigation work, and that the average number of grubs per stool was very high in most cases, the results obtained are quite good.

The results of several other blocks which will cut larger tonnages will not be available until the cane is harvested later in the season.

Block 1.—Six acres of Badila, four and a-half fumigated. Block averaged 27 tons per acre, while the unfumigated portion had to be ploughed out and replanted. The fumigated portion ratooned well.

Block 2.—Six acres of Badila plant, all fumigated. Cut 31 tons per acre. Average of ten grubs per stool before fumigation.

Block 3.—Fifteen and a-half acres of Badila plant, average of eighteen grubs per stool. Cut just over 20 tons per acre.

Block 4.—Ten acres of Badila plant, average fourteen grubs per stool. Cut 22 tons per acre.

Block 5.—Eighteen and a-half acres Badila, first ratoons, average eight grubs per stool. Cut 22 tons per acre, in spite of being fumigated after the cane was already showing serious damage. This block when fumigated last year (1932) cut 45 tons per acre.

Block 6.—Seventeen acres, D. 1135 plant, average about four grubs per stool. This block was fumigated with a light dose, and, although not yet harvested, will probably cut 30 tons per acre.

The total area of cane fumigated in the North this year is more than 800 acres; and indications seem to show that a still larger area will be fumigated during the coming season.

In the above connection it may be mentioned that seventeen farmers in the South Johnstone district fumigated 140·66 acres, at an average cost of £7 15s. 1d. per acre, with satisfactory results, 87 to 96 per cent. of the grubs being destroyed. In certain cases 100 per cent. kill was obtained. "It is interesting to note that in one instance carbon bisulphide was used without the addition of paradichlor., the kill being 87·5 per cent., which was considered to be a very good result, as the grubs not killed were occasional stragglers outside the radius of fumigation."

It was estimated that 3,500,000 grubs were killed by fumigation in the South Johnstone area during the one season.

Life-history and Control of our Greyback Cockchafer.

This question has been discussed in a series of contributions published in the *Queensland Agricultural Journal*, which are intended to subsequently take the form of a Farm Bulletin. This will contain twelve plates and sixteen inset figures, illustrating the life-cycle stages of our chief cane-beetle; its subterranean and aerial activities throughout each month of the year; approved methods for controlling its ravages during the egg, grub, pupal, and adult stages of development; and the biological control effected by its insect enemies and fungus diseases.

Although by no means exhaustive, the treatise in question will be the most comprehensive yet published dealing exclusively with the economy of our greyback cockchafer.

Division of Entomology—continued.

Experiments with White Arsenic.

Notwithstanding failure of the experiments against greyback grubs at Greenhills by Dr. J. F. Illingworth during 1919-1921, some of the growers at Giru, in the Ayr district, claim to have lately obtained encouraging results with white arsenic against this cane-beetle. Accordingly some experiment plots were laid down in order to furnish farmers of the Lower Burdekin with reliable data regarding the value of arsenic as a grub control. Five plots were established last May by Mr. J. H. Buzacott (Assistant Entomologist) at Giru, and one plot at Ayr, each laid out as randomised blocks, five of which had three treatments, with four replicates of each treatment, whilst in the sixth plot there is provision for a treatment also of carbon bisulphide during February or March of next year (1934). Arsenic was applied at the rate of 60 and 200 lb. per acre. In August, four months later, living grubs were still present in the blocks that had received large dressings of arsenic.

Visits to Other Sugar Districts.

Giru.—Three times, February-March, May, and August. Establishment and inspection of arsenic plots.

Ayr.—Once in May. Establishment of arsenic plots.

South Johnstone.—Once in March. Advising with regard to fumigation at Experiment Station.

Babinda.—Three visits—August, September, and October. Collecting puparia of *Ceromasia sphenophori*.

Pawngilly and Bartle Frere.—Sundry visits. Releasing Tachinid flies on borer-infested farms.

Eubenangee, Jogo, Mopo, Freshwater, Meerawa, Innisfail, Tully.—Several visits. Releasing Tachinid flies and establishing standover sanctuaries for the parasites.

Transmission of Cane Diseases.

Experiments were instituted at this Experiment Station by the Assistant Entomologist during August last with a view to seeing whether the diseases known as Leaf-scald and Pseudo-scald can be carried by insect vectors. Setts of susceptible canes were accordingly planted, and when properly established an attempt will be made to infect the healthy shoots by means of insects fed on diseased canes.

Distribution of the Tachinid Fly.

Supplies of Tachinid flies (*Ceromasia sphenophori* Vill.), used for distributing amongst borer-infested cane, have recently been obtained by cutting out puparia in the field from cane sticks containing cocoons of the Weevil Borer *Rhabdocnemis obscurus* Boisd., and hatching out the flies from same at the Meringa Station. This plan has been found to give quicker results than the propagation of these parasites under artificial conditions in large breeding-cages. Since August, 1933, Mr. Buzacott reports that 1,428 flies have been released in the field, and there are in the laboratory about 500 puparia still to hatch. The flies have been liberated on twenty-one different farms, on some of which flies had never been previously released. In many instances large numbers of puparia occurred in the sticks, indicating the decided spread of this useful parasite.

All the cutting out of puparia has been carried out on Mr. Jackson's farm at Babinda, and his co-operation and that of the gang have been essential to success.

In cane which has been lying in the sun a long time the fly maggots seldom survive, although in many cases puparia procured from such sticks have emerged. Still the mortality due to sun-baking is so high that it is advisable to follow the cutting gang closely.

Borer damage is rather more severe in the North this year than for many years past. "This is attributable," says Mr. Buzacott, "to several factors, the chief of which are lodging of the cane owing to continuous wet weather, serious rat damage allowing

easy oviposition by the borer, and the presence of the fungus causing binding of the leaf-sheath which forms a shelter for the beetles and prevents the Tachinid flies from gaining access to the fractures in the cane rind caused by borers. However, in most places where the parasite is present, the damage caused by the borers is not excessive, and, except for two notable cases, the fly was not found on any farms where puparia were located."

Collecting Cane-beetles.

Some of our growers are beginning to realise the fact that leading entomologists as a whole, after working more than thirty years on the cane-grub problem, are still advocating the continuance of this commonsense method of control.

In the Philippines, for example, we read in the Annual Report of the Sugar Bureau as follows :—" White grubs caused less damage to sugar-cane on the western coast of Negros during 1930-31 than in the previous year, probably owing to adverse climatic conditions, and, in the opinion of the Entomologist (A. W. Lopez), to the extensive collecting of larvæ and adults carried on in 1930, when seven million of these cockchafer beetles were collected in one locality."

Similarly, in the campaign against the cockchafer *Phytalis smithi* Arr. in Mauritius during 1930-31 a total of " 324 million adults and 64 million grubs " were collected.

In Queensland, however, by concentrating our efforts on the greyback, which is the chief cane pest, the expense of collecting would be much reduced and better results secured than if including adults of *Lepidiota frenchi* Blkb. in the campaign. In previous reports I have many times outlined the best methods to be adopted in such control work, enumerating the favourite feeding-trees of the greyback cockchafer (*Lepidoderma albohirtum* Waterh.), and how and when to collect the beetles from same.

Museum of Sugar-cane Entomology.

More interest could with advantage be shown by our growers in practical nature-study relating to the economy and habits of the various insects to be met with in cane-fields. Unless able to discriminate between insect friends and foes, the former are likely to be mistaken at times for injurious species and promptly destroyed.

The small museum which can now be seen at Meringa Experiment Station contains specimens of practically all the insects known to attack sugar-cane in North Queensland, together with their principal enemies, while primary pests such as the greyback and French's cane-beetles and the Weevil Borer of cane sticks, &c., are exhibited in all stages of development—from egg, larva, pupa, to adult forms.

When uncertain of the habits of any insect noticed injuring cane stools, a sample should always be forwarded without delay to the Entomologist at Meringa. Growers are welcome to come in when passing the station and discuss any matters pertaining to cane insects at a place where full information can be obtained, illustrated by examination of museum specimens associated with any species under discussion. Such concerted action would doubtless promote better understanding between farmer and entomologist.

Entomological Exhibits at Agricultural Shows, Etc.

This Experiment Station was again represented at the annual meeting of the Cairns Agricultural, Pastoral, and Mining Association held at Parramatta Park during July last.

The entomological display was much appreciated, and many growers availed themselves of the invitation to discuss with the Assistant Entomologist, who was in charge, matters of interest in connection with the distribution of Tachinid fly parasites, grub fumigation, &c.

Amongst other novelties, a large breeding-cage containing living caterpillars of the Army Worm (*Cirphis unipuncta* Haw.) excited much attention.

Division of Entomology—continued.

A general collection of the grubs, pupæ, and adults of root-eating Scarabæid beetles attacking cane and other crops was also on view, together with large coloured diagrams illustrative of the underground workings and life-cycle stages of our greyback cockchafer, and effects produced by grubs of this beetle on crops of cane during each month of the year, and the economy of the Tachinid parasite of the Beetle Borer.

By special request from the Secretary of the North Queensland Naturalists' Club a small collection of insects attacking sugar-cane and other interesting species was exhibited last August at the annual exhibition of the above society, held in the Oddfellows' Hall.

CENTRAL STATION, MACKAY.

W. A. McDougall, Assistant Entomologist.

General.

Some damage by both the adults and grubs of *Pentodon australis* Blbn. occurred in early plant cane, but over the whole year this insect was not as destructive as it had been during the previous three years.

The moth borer, *Phragmatiphila truncata* Walker, continues to lightly infest standing cane over an extensive area. Patches of cane damaged by this pest may be found here and there over a clean field, but it is the cane adjacent to headlands or in grassy fields that is usually affected. Generally speaking, the damage is not of much importance, but in some instances it is heavy enough to be a serious consideration.

The beetle borer, *Rhabdocnemis obscurus* Boisd., was noticed in one or two localities. The cane damaged by it was either one of the softer varieties growing in a damp scrub situation or grown from borer-infested plants. In one instance a case of borer damage when investigated proved to be an infestation by a Cerambycid. The larvæ of this beetle seemed to live in dry dead sticks only; the field, a badly diseased one, contained many such sticks.

Cane Grubs.

During the past year damage by these pests was not very extensive. It was confined to a few small patches, mostly in ratoons. The last "greyback" flight was a very light one; 13,421 lb. of beetles were collected.

Wireworms.

In the early plant of this year damage by this pest was evident in a number of fields. July rains delayed the usual late plantings so that, especially in low country (the habitat of the wireworm pest species), much of the planting was done in September or even as late as early October. Under these conditions good strikes were usually obtained on "wireworm" country.

The British Museum has identified some of the adults bred from the different wireworms found in the Mackay district. *Lacon variabilis* Cand. is the serious pest species. The common highland species has been identified as *Heteroderes carinatus* Blbn. Other common species named are *Heteroderes cairnsensis* Blbn., *Lacon assus* Cand., *Lacon lateralis* Schw., and *Lacon humilis* Er.

In the 1932 Annual Report mention was made of breeding a *Lacon* sp. (*L. variabilis*) from egg to adult. This past year the breeding work with wireworms was continued. With a better knowledge of the environmental conditions desired by the smaller instars of the different species, a better understanding of the occurrence and behaviour of the larvæ in the field has been obtained, and also the breeding work has been more successful. All the Elaterid species mentioned above (with the exception of *L. assus*), several other *Lacon* spp. and *Heteroderes* spp., as well as some members of other genera whose larvæ are of the semi-flattened yellowish type, are now known to have one-year life-cycles under Mackay conditions. *L. variabilis* normally passes through eight larval instars.

Further field experiments with poisons against these pests gave negative results.

Division of Entomology—continued.

It was found that wireworm damage may occur in soils containing from 0·9 per cent. to 5·4 per cent. organic material; in the Mackay district there is no correlation between the occurrence of damage by *L. variabilis* and the amount of organic matter in the soil.

A series of soil-moisture samples taken weekly from October to June showed conclusively that excessive wet is necessary during the months of December, January, or February for the establishing of a wireworm population in any field. Once established very little can be done to combat these wireworms, which may make their presence felt if this badly drained country is planted to cane during the eight or nine months following the soaking. Again this year several drainage experiments were successful against *L. variabilis*.

Dwarf Disease.

Dwarf disease is the name recently adopted for what is probably a new virus disease of sugar-cane. So far as is known, it is confined to a small portion of the Mackay district. Efforts are being made to find a possible insect vector of this disease. During March and April attempts to transmit dwarf from stunted primary-infected P.O.J. 2714 to healthy shoots of that variety by *Aleurodes berghi* Sign. and *Aphis sacchari* Zehn. were not successful. In October negative results were also obtained when using *Perkinsiella saccharicida* Kirk. (both adults and nymphs) as a possible vector and secondary-infected P.O.J. 2714 as the inoculum.

From field observations it seems as if the disease first shows up as a secondary spread in suitable localities during January and February. As this disease is probably indigenous, and on account of the possibility of its having come from grasses or weeds to cane and its not spreading from cane to cane, all fields from which dwarf has been reported have been inspected this year. Following this survey, the disease has been found on numerous farms from which it had not been previously reported and in circumstances which may prove helpful in vector work during the coming wet season.

On one farm a number of sticks of Malagache appeared to be diseased. When cut and planted out the resulting growth was very poor, and sections of the leaves of this poor growth showed deranged vascular bundles similar to those found in primary dwarf in P.O.J. 2714.

Previously dwarf had been reported as occurring in P.O.J. 213, P.O.J. 2714, E.K. 28 (doubtful), and H.Q. 426.

SOUTHERN STATION, BUNDABERG.

Mr. R. W. Mungomery, Assistant Entomologist.

General.

In the Southern sugar districts damage by the cane-grub, *Pseudoholophylla furfuracea* Burm., has been particularly light during the past year, but in parts of the Isis and Gin Gin districts grubs have appeared in greater numbers since the early spring rains, and this pest continues to be the greatest entomological problem directly affecting canegrowers in South Queensland. In a few instances soil fumigation is still being carried on as a means of combating these pests, but this form of control must eventually give place to the cheaper and more effective method of preventing damage by proper and timely cultural operations, aimed at reducing the initial grub population before planting time. Biological control of the pest is also being attempted, but, as indicated elsewhere, droughty periods and light grub infestations unfortunately followed our liberations of parasites.

The transmission of Fiji disease of sugar-cane has constituted the main problem investigated during the past year, and this line of work will be continued, for although it has been established that *Perkinsiella saccharicida* Kirk. is a vector of this disease, other points bearing on the control of the disease still require elucidating. This work, together with certain observations on pests of minor importance, is set out hereunder.

Division of Entomology—continued.

Fiji Disease Transmission Investigations.

Following on our previous preliminary work in tracing the vector of this disease by using mixed colonies of insects, we were able to eliminate certain sap-sucking insects, and finally narrowed down the possible vectors to three—namely *Perkinsiella saccharicida* Kirk., *Trionymus sacchari* Ckll., and *Aphis sacchari* Zehnt. These insects were then tested separately, and eventually cane stools in those cages where *P. saccharicida* had been caged showed typical Fiji disease symptoms. Further tests using these three insects separately, both in isolated plots of cane and also on cane grown in tubs of soil, confirmed the fact that *P. saccharicida* is a vector of this disease. At the same time these tests also showed that *Aphis sacchari* and *Trionymus sacchari* were incapable of spreading the disease.

In some cases where the leaf-hopper, *P. saccharicida*, was used in these transmission experiments no disease resulted, even though the feeding periods on the diseased and healthy plants seemed adequate for transmission to have taken place. However, on being further investigated, these cases were found to occur where leaf-hoppers had been bred to the adult stage on healthy cane and were used for these experiments subsequent to assuming the adult condition. Where nymphs which had been bred on diseased cane were used in these experiments, in nearly all cases transmission occurred, and it is, therefore, likely that this leaf-hopper must acquire its power to become infective in one or more of its nymphal stages. Further experiments to determine this point are being carried out at the present time. The period of latency of the symptoms has been shown to vary from about two months in the summer to possibly five or six months during the winter period, but more exact data is now being sought concerning this matter. The effect of dry weather on the masking of symptoms is also being investigated.

In conjunction with these experiments, leaf-hopper population studies were undertaken, and these have shown that leaf-hoppers are most plentiful in vigorously growing cane, whereas in poorly grown cane or in very tall cane they are extremely scarce. From field counts, Fiji disease is known to spread more rapidly in vigorously growing cane than in poorly growing cane; hence a positive correlation exists between leaf-hopper abundance and the rate of spread of the disease. With regard to tall cane, some factor or factors other than leaf-hardness are thought to be responsible for the scarcity of leaf-hopper in these crops.

The results of our investigations to date on this subject have been published conjointly with the Pathologist in Bulletin No. 4, Division of Pathology.

Parasite Importation.

Through the courteous co-operation of Dr. Gibson, Dominion Entomologist of Canada, another consignment of Tachinid flies (*Microphthalma michiganensis* Towns.), was forwarded from the Hemmingford Laboratory in an attempt to establish this species as a parasite of the Scarabæid *P. furfuracea* Burm. These insects arrived in Bundaberg during November. Following the plan of previous years, the flies were forwarded in the larval stage as internal parasites of *Lachnosterna* grubs, and during the journey from Canada they were kept in cool-temperature storage. The survival of *Lachnosterna* grubs amounted to 85·4 per cent., which represents a decided improvement on the results of the previous consignment. This is no doubt due to the better handling during the different sections of the voyage, and also to the better ventilation of the containers, whilst at the same time due provision was made to keep them sufficiently moist during the whole journey. The percentage of *Lachnosterna* grubs parasitised by these fly maggots was, however, small, amounting to only 10·8 per cent., and 207 flies were bred from the puparia obtained. Of these flies, 160 were liberated during January and February near grub-infested fields on Hapsburg plantation, in the Isis district. Conditions for liberation were not ideal, as grub infestation was somewhat light. Dissections of cane-grubs collected recently in the neighbourhood of where liberations were made, did not reveal the presence of these parasites, but it is somewhat premature to expect that any recoveries would be made so soon following the liberations.

Division of Entomology—continued.

Army Worms Attacking Young Cane.

Severe infestations of army worms (*Cirphis unipuncta* Haw.) occurred in several fields of cane during the last spring and summer, both in areas where trash conservation had been carried out and also in places where young cane had been frosted, and on that account had much dead trash adhering. In some years parasites are able to keep these pests in check, but periodical dissections during the past season showed them to be suffering only a low percentage of parasitism as late as November, and young ratoons were in danger of being ruined by these caterpillars. Bran-Paris Green baits were recommended, and many farmers obtained a high degree of control by this means, ratoons then coming away normally. Of the parasites that were bred from these army worms, a large species of Tachinid fly and an Ichneumon (*Heniscospilus* sp.) were the most plentiful.

Influence of Cane Trash Conservation on Scarabæid Grub Infestation.

This question has hitherto not received the attention that is demanded of such a subject, due primarily to the difficulty of locating areas where trash has been conserved systematically over a long period of years. For no apparent good reason, many growers seem to be possessed of the idea that trash conservation tends to attract beetles for oviposition purposes, and, therefore, that trash is responsible for the appearance of grubs in their fields in subsequent years.* Partly for this reason and partly on account of the difficulty of adequately disposing of large bodies of dry trash, they have been disinclined to follow such a practice. In many cases, where, on cutting the final ratoon crop, a body of trash has been turned under when ploughing out the old stools, no noticeable increase in grub population has been apparent over the succeeding years, and there appears to be no reason for such an assumption. However, during the last year we were able to witness the effect of conserving large bodies of trash yearly during the past ten years on red volcanic land, which is in every way typical of the soil in which the Southern cane-grub (*Pseudoholophylla furfuracea* Burm.) is commonly found. The previous crop had been carried to the fourth ratoon (five years), which fact in itself, by allowing succeeding generations of grubs and beetles to breed there unmolested, would be sufficient to increase greatly the number of grubs normally present. Despite these favourable conditions, grub infestation was particularly light, amounting to less than one grub in two chains of furrow on the average—an almost negligible quantity. Though it is admitted the instances we have been able to investigate were not great, still, up to the present we have no evidence to condemn trash conservation on the ground of its encouraging grub damage later.

Minor Cane Pests.

Chrysomelid Larvæ Attacking Cane Setts.—Over-wintering larvæ of *Rhyparida morosa* Jac. were found to be attacking cane setts planted in newly ploughed grassland, by boring directly into the setts and eating the more succulent internal tissues. As the eyes swell and shoots appear, these are also destroyed. Plantation managers or farmers who contemplate establishing nursery plots for clean seed would be well advised to prepare their land from six to twelve months beforehand, so as to guard against the danger of such native grassland pests turning their attention to cane setts as soon as they are planted.

Wireworm.—During the last spring, damage by Elateiid larvæ of a serious and somewhat unusual nature occurred on a red volcanic soil farm in the Woongarra district, where setts have

* This idea has probably become popular through the fact that young ratoons crops frequently become infested with "army worms" where cane trash is allowed to remain on the ground and the shoots volunteer through. Some growers refer to these army worms as "grubs," though the latter term is applied more frequently in these districts to the larvæ of Scarabæid beetles, and not as a general rule to Noctuid caterpillars; hence, through their failure to discriminate between the two pests and maintain their separate identities, it can readily be understood why this erroneous idea of cane-grub infestation following trash conservation has gained ground.

Division of Entomology—continued.

been destroyed, and poor strikes have resulted. These soils, for the most part, are well drained, and are not superficially comparable with some of the low-lying fields near Mackay, where wireworm damage is usually so severe. Some of these pests have been collected for breeding to the adult beetle so that a better understanding of the habits of the beetle and larvæ may be gained.

Margarodes sp. on Cane Roots.—These insects were found in large numbers in the encysted stage, attached to cane roots. They occurred on a sandy loam farm near Bundaberg, but they do not appear to be capable of doing more than minor damage to the stool. During October and November adult females emerged from their pearly tests, and were found laying eggs in the soil at depths varying between 3 and 6 inches. Specimens of this insect have been sent to the British Museum for identification.

Division of Mill Technology.

Mr. E. R. Behne, Assistant Technologist.

Introduction.

Since the last Annual Report no alterations have been made in the staff.

As previously, the laboratory work has been confined practically to the standardisation of apparatus. In addition, investigations were carried out on the relations between pH, P_2O_5 content and clarification of cane juice, and also the rate of inversion of clarified juice with continued boiling, together with several calorific value determinations and general analyses.

Mill Investigations.

During the crushing season the Assistant Technologist visited all mills outside the C.S.R. mills, special work being attempted at two or three. Boiler tests were carried out at Tully on all boilers and, in particular, on a new Cook furnace operating on preheated air. The results on this furnace agreed with those obtained at Kalamia last season, and prove definitely the value of this type of furnace. The use of the preheater increases the overall thermal efficiency of the boiler by about 4 per cent. By suitable application of lagging it is expected to make this improvement about 7 per cent.

At Tully, a Leeds Northrup pH recorder was installed by this Division to assist in controlling the addition of lime in defecation. Owing to a series of setbacks this instrument has not yet been placed in continuous operation, due chiefly to unavoidable delays. The recorder is so fitted that it can be made to operate an automatic limer, and negotiations are being made at present for the necessary gearing and drives for this purpose. It is confidently hoped that before the end of the present season, not only will the recorder be working continuously, but that the automatic control will also be applied successfully.

It has been demonstrated many times that the quantity of lime required to bring juices up to a definite pH value is not constant for all juices, and can vary within very wide limits. Consequently, if it be desired to lime to a definite value, tests and adjustments must be made at very brief intervals; this takes considerable time and also introduces the personal error of the workmen. Further, it is the practice at present to sample the clarified juice as it leaves the subsiders, and this introduces a lag of up to three-quarters of an hour after the application of the lime. In the installation at Tully the juice is tapped as it leaves the superheaters—a lag of about five minutes only. It was necessary to filter and cool the juice, and considerable time was spent before an efficient filter of sufficient capacity to run for twenty-four hours without cleaning was developed.

At the Mulgrave Mill several tests were made to investigate the influence of subsider capacity when liming to different pH values. A De Laval separator was used for the purpose of determining the completeness of defecation.

Standardisation of Apparatus.

Brix Spindles.—Two hundred and one spindles were tested and official certificates issued for all but seventeen. Of the latter, nine spindles were partly outside the range of the standard spindles—the remaining eight showed errors in excess of $\pm$ ·1° Brix.

Division of Mill Technology—continued.

Polariscope Tubes.—Nine were tested, and all were within the limits of accuracy required.

Flasks.—Twelve flasks were tested and eight rejected.

Pipettes and Burettes.—Six were tested and three were certified.

Analytical Weights.—Six sets were tested.

Thermometers.—Fifteen thermometers were tested.

Polariscopes.—Four polariscopes were cleaned and tested.

Mutual Control.

This scheme was advanced one step further this year when two more mills were admitted, making a total of twenty-two supplying figures for comparison.

The synopsis for last season (including plant figures and the averaged crushing figures for the season) was completed, and copies sent to each mill in the control. During the visits of the Assistant Technologist this year the plant data were checked up, and any alteration noted for the preparation of the second synopsis.

A booklet of methods of analysis to be used in the Queensland Sugar Mills is in course of preparation, and contains notes on apparatus, methods of analysis, and complete reference tables. This will be completed and issued early in the coming year.

Each mill this year has a key to the identity of the numbers used in the control.

Mill Work for Season 1932.

Reduced sugar values during recent years have forced the mills to devise means of reducing their costs of manufacture, and the result has been more intensive crushing. Each year has brought an increase in the crushing rate, while the chemical efficiency of manufacture or overall recovery has been maintained at approximately the same level as hitherto. The term "chemical" efficiency is sometimes used in contradistinction to "economic" efficiency—which after all is the all-important criterion of the yearly work. Although we are unable to gauge precisely this latter efficiency, it is logical to assume that it is sound economics to effect a larger output in a given period without sacrifice of chemical efficiency.

Moreover, it is very difficult to compare one season's work with that of the previous season; there are so many variables which play such an important part in the mill work, and of these, perhaps the greatest—both in effect and variability—is the weather. It has often been said that sugar is made in the field, and the underlying truth of this is only too clearly shown when a stunted drought-stricken crop has to be treated. Both 1931 and 1932 seasons, in the Central and Southern districts, were particularly bad, due to severe frosts following on a prolonged drought. This was exceptionally severe in the Bundaberg district last season, when the purity of the first expressed juice averaged 84·95, and the gallons of molasses per ton of cane 5·97. In some mills where the conditions were most acute, the purity of first expressed juice was as low as 80, and the yield of molasses as high as 8 gallons per ton of cane. Two mills in this district did not crush, but transferred what little cane there was to a neighbouring mill.

The low tonnages prevailing in the Southern district, compared with the high total tonnages in the North, obscure to a certain extent the effect of the poor figures in the South, in the overall averages. Nevertheless there is a drop of about a unit in purity of the first expressed juice, and an increase in the gallons of molasses per ton of cane equal to about 0·2 when compared with the previous normal season (1930).

Division of Mill Technology—continued.

The following tabulation for the years 1930-32 shows the extent of the effect of the conditions in the Southern district :—

SOUTHERN DISTRICTS.

——	1930.	1931.	1932.
Tons of cane	647,794	691,247	208,591
Tons of 94 n.t. sugar	84,114	91,546	23,747
Tons cane per ton 94 n.t. sugar	7·72	7·551	8·784
Pol in cane	14·58	15·01	13·32
Fibre in cane	15·00	15·40	15·16
Purity—			
First expressed juice	89·91	88·25	84·95
Clarified juice	89·00	87·77	83·87
Syrup	88·51	87·37	83·59
Gallons molasses per ton cane	4·66	4·73	5·97
Apparent purity, final molasses	..	40·90	39·06
Overall recovery	85·32	85·13	81·62
Recovery on mixed juice	90·42	90·45	87·42
Crop days	..	1,257	442

In the Central district the conditions last season although subnormal were not as acute as in 1931, as will be seen from the following table :—

CENTRAL DISTRICTS.

——	1930.	1931.	1932.
Tons cane crushed	1,155,912	1,265,744	1,283,821
Tons 94 n.t. sugar made	176,619	189,440	190,995
Tons cane per ton 94 n.t. sugar	6·53	6·682	6·722
Pol in cane	16·80	16·73	16·22
Fibre in cane	13·06	12·42	11·99
Purity—			
First expressed juice	91·70	89·93	90·02
Clarified juice	91·30	88·88	89·38
Syrup	91·60	89·20	89·52
Gallons molasses per ton cane	3·61	4·65	4·60
Apparent purity, final molasses	40·52	40·45	39·50
Overall recovery	86·69	85·35	86·56
Recovery in mixed juice	92·23	91·35	91·77

In the Northern district there has been a gradual improvement over the three years. The weather conditions have been favourable for good crops, but when it is considered that the greatest increases in crushing rate have been made in the North, this improvement is all the more meritorious. One factor which may contribute in a large measure to this improvement is the increased crushing rate enabling the cane to be harvested when more nearly mature, and thus obviating the serious falling-off in quality which occurs when the crushing is long drawn out.

Division of Mill Technology—continued.

The following figures illustrate the above comments :—

NORTHERN DISTRICTS.

——	1930.	1931.	1932.
Tons cane crushed	1,717,999	2,078,138	2,054,031
Tons 94 n.t. sugar made	254,537	300,289	299,343
Tons cane per ton 94 n.t. sugar	6·75	6·920	6·862
Pol in cane	15·98	15·56	16·07
Fibre in cane	11·38	10·61	10·51
Purity—			
First expressed juice	90·77	89·94	90·11
Clarified juice	90·59	89·79	89·83
Syrup	90·77	90·02	90·30
Gallons molasses per ton cane	3·39	3·61	3·63
Apparent purity, final molasses	39·55	35·33	37·33
Overall recovery	87·63	87·67	87·85
Recovery on mixed juice	92·22	92·40	92·43

The following tabulations show that, *primâ facie*, the milling work for the entire Queensland industry has maintained its high level of efficiency over the past three years in spite of the increased crushing rates, but when the adverse conditions already mentioned are taken into consideration one is led to conclude that had favourable conditions prevailed throughout there would have been a marked increase in efficiency.

ALL QUEENSLAND DISTRICTS.

——	1930.	1931.	1932.
Tons cane crushed	3,521,705	4,035,129	3,546,443
Tons, 94 n.t. sugar made	515,270	581,276	514,085
Tons cane per ton 94 n.t. sugar	6·84	6·942	6·885
Crushing rate	45·98	48·49	53·38
Pol in cane	15·97	15·94	15·90
Fibre in cane	12·59	12·28	11·51
Purity—			
First expressed juice	90·90	89·59	89·64
Clarified juice	90·50	89·06	89·15
Syrup	90·60	89·28	89·42
Gallons molasses per ton cane	3·70	4·18	4·18
Apparent purity, final molasses	40·65	39·19	38·31
Pol extraction	94·49	94·10	94·58
Overall recovery	86·83	86·37	86·88
Recovery on mixed juice	91·89	91·79	91·86
C.C.S. in cane	14·957	14·798	14·767
Coefficient of work	97·82	97·35	98·15

Division of Mill Technology—continued.

The following table shows the results for each district for season 1932, and the average for the industry :—

——	Northern.	Central.	Southern.	Totals and Averages.
Tons cane crushed	2,054,031*	1,283,821*	208,591*	3,546,443*
Tons sugar made (94 n.t.)	299,343*	190,995*	23,747*	514,085*
Net titre	96·89	96·78	96·55	96·82
Tons cane per ton sugar (94 n.t.) ..	6·862*	6·722*	8·784*	6·885*
Fibre, per cent. cane	10·51	11·99	15·16	11·51
Pol per cent. cane	16·07	16·22	13·32	15·90
Bagasse—				
Moisture	52·27	52·18	51·41	52·16
Pol	3·30	3·34	2·61	3·26
Purities—				
First expressed juice	90·11	90·02	84·95	89·64
Clarified juice	89·83	89·38	83·87	89·15
Syrup	90·30	89·52	83·59	89·42
Brix of syrup	67·67	68·10	68·62	67·93
Gallons molasses per ton cane ..	3·63	4·60	5·97	4·18
Purity of final molasses—				
Apparent	37·33	39·50	39·06	38·31
True	47·70	50·57	47·19	48·37
Pol of sugar	98·44	98·25	98·37	98·35
Fuel used—B.T.U.'s added per lb. cane	122	192	195	157
Gallons clarified juice per ton cane ..	216	214	231	216
Pol extraction	95·05	94·32	93·37	94·58
Extraction ratio	·471	·474	·437	·471
Milling loss	7·57	7·70	5·82	7·48
Pol in sugar—				
Per cent. pol. in cane	87·85	86·56	81·62	86·88
Per cent. pol. in mixed juice ..	92·43	91·77	87·42	91·86
Crop days	1,653	1,181	442	3,276

* All mills, remainder exclusive of C.S.R., Pioneer, and Inkerman Mills.

Crushing for the 1932 season was commenced on 24th May, and was not completed until 29th December, 1932. The first mill to start was Victoria, and the last to cease was Kalamia.

Ths maximum harvesting period was 203 days at Victoria, and the miminum was 21 days at both Childers and Gin Gin.

Division of Mill Technology—continued.

Cane Milled and Sugar Yields, Season 1932.

	Tons Cane Crushed.	Tons 94 N.T. Sugar made.
Mossman	106,612	15,239
Hambledon	207,428	29,830
Mulgrave	219,926	31,177
Babinda	207,146	30,885
Goondi	164,667	24,626
South Johnstone	237,945	35,121
Mourilyan	168,179	25,990
Tully	259,526	38,834
Victoria	234,756	32,292
Macknade	247,846	35,349
Total, Northern District	2,054,031	299,343
Invicta	77,931	11,953
Pioneer	129,069	19,900
Kalamia	170,757	26,331
Inkerman	167,950	25,886
Proserpine	123,380	17,938
Cattle Creek	60,426	8,598
Racecourse	96,028	13,596
Farleigh	100,162	14,594
North Eton	41,274	5,459
Marian	97,976	14,179
Pleystowe	99,002	14,432
Plane Creek	119,866	18,129
Total, Central District	1,283,821	190,995
Qunaba	Did not crush	
Millaquin	27,632	3,017
Bingera	27,237	3,010
Fairymead	53,031	5,486
Gin Gin	5,166	557
Childers	8,965	1,074
Isis	17,719	1,895
Maryborough	7,228	841
Mount Bauple	Did not crush	
Moreton	52,001	6,826
Rocky Point	8,566	936
Eagleby	1,046	104
Total, Southern District	208,591	23,746

Brisbane, 30th November, 1933.

H. W. KERR,
Director.

Price, 2s.]

By Authority: FREDERICK PHILLIPS, Government Printer, Brisbane.